C. J. Willard

Proceedings

NORTH CENTRAL STATES WEED CONTROL CONFERENCE

1944

PROCEEDINGS

NORTH CENTRAL STATES WEED CONTROL CONFERENCE

OMAHA, NEBRASKA
NOVEMBER 16 AND 17, 1944

ISSUED BY
EXTENSION SERVICE
NEBRASKA COLLEGE OF AGRICULTURE
AND
DIVISION OF NOXIOUS WEEDS
NEBRASKA DEPARTMENT OF AGRICULTURE AND INSPECTION

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FOREWORD

This Conference was called because of the general opinion among many weed control officials that there was urgent need for bringing together weed workers from the various states of the North Central Region to discuss mutual problems.

The weed control workers in Kansas, Minnesota, and Nebraska designated those states as co-sponsors of the conference to be held in Omaha, Nebraska. The decision was for the weed control agencies in the host state to send out invitations. The Nebraska State Department of Agriculture and Inspection, and the College of Agriculture, readily accepted this task with the assistance of the co-sponsors.

Following is the report of proceedings of the conference.

FIRST SESSION - November 16

Registration . . . . . Total = 90

Regulatory.	.28
Research.	.20
Extension	.16
Commercial.	.14

Mr. Rufus M. Howard, Director, Nebraska Department of Agriculture and Inspection was introduced as chairman of the first session by Mr. W. L. Klatt, State Weed Supervisor of Nebraska.

Mr. Howard: It is indeed a pleasure to extend a welcome to you gentlemen attending this conference. We are glad you are holding this meeting in Nebraska. The North Central States represented at this meeting are some of the most important agricultural states in this country, and it is certainly fitting that they should be in the forefront in initiating a practical and intelligent program for weed eradication. There are few subjects in the scope of agricultural problems that provoke more interest than the struggle against the weed menace.

It is encouraging to meet with representatives from other states who are interested in weed control measures, and appreciate the need for, and importance of, closer cooperation and an interchange of ideas between the states. Such cooperation will greatly assist in adequately combating the weed menace. The resultant problems of seed infestation, lowered soil fertility, and reduced value of farmlands must be given more consideration. It is the benefit of knowledge of your experiences in meeting those problems in your states that will be helpful and we hope that we have something to offer from our experiences that may be helpful to you. Farming is a never ending struggle against weeds, and we well know from our own observation in Nebraska that weed eradication has been too long delayed.

Remarkable progress has been made in other phases of agriculture. We grow better livestock, raise better varieties of grain, and, in fact, grow better crops of all kinds. We have not, however, been sufficiently alert to the danger and extent of the infestation of our farmlands by the noxious weeds. It is a major threat to the efficient and economical production of crops.

This meeting is most timely and thoughts expressed here should be given the recognition they deserve in postwar agricultural planning. I am confident that much will prove to be beneficial and helpful from your deliberations.

Mr. Yost: Mr. Chairman, I think that this is the appropriate time to designate a temporary secretary to take care of the minutes of this meeting and I make a motion that Mr. Noel S. Hanson of the Agronomy Department of the University of Nebraska, be designated as the temporary secretary and be responsible for getting out the official report of this convention. (Seconded and passed without opposition.)

Mr. Howard: The motion has been carried that Mr. Hanson be designated as the temporary secretary. Mr. Hanson, will you please come forward and take over your duties as the secretary?

Mr. Hanson: The young ladies are taking down the minutes of the meeting. We will see that this report gets out as quickly and efficiently as possible.

Mr. Howard: I think the representatives here are pretty well acquainted with one another but it might be a good idea to have the representative from each state introduced in order that we can get better acquainted. I think all of the states listed are represented.

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Laramie,

Mr. Howard: Four Committees have been selected. We will hear their reports tomorrow, but I believe we will have each chairman announce the membership of his committee now.

Plans for a Post-war Weed Program Committee

Mr. D. L. Gross, Extension Agronomist, University of Nebraska, (Chairman)
Dr. H. K. Wilson, Professor of Agronomy, University of Minnesota
Mr. W. J. Leary, Extension Agronomist, North Dakota State College
Mr. J. R. Fleetwood, Extension Specialist in Farm Crops, University of Missou
Mr. L. W. Kephart, Senior Agronomist, U. S. Department of Agriculture
Mr. U. J. Norgaard, Extension Agronomist, South Dakota State College

Research Committee

Mr. F. L. Timmons, Associate Agronomist, U. S. Department of Agriculture, (Chairman)
Dr. A. L. Bakke, Research Professor of Botany, Iowa State College
Mr. J. W. Zahnley, Associate Professor of Agronomy, Kansas State College
Mr. A. H. Larson, Assistant Professor of Botany, University of Minnesota
Mr. N. S. Hanson, Assistant Professor of Agronomy, University of Nebraska

Resolutions Committee

Dr. H. K. Wilson, Professor of Agronomy, University of Minnesota, (Chairman)
Dr. W. W. Worzella, Head, Department of Agronomy, South Dakota State College
Mr. J. L. Hutchison, Assistant State Weed Supervisor, Kansas State Board of Agriculture
Mr. L. F. Smith, Assistant State Weed Supervisor, Nebraska Department of Agriculture and Inspection.
Mr. G. M. Briggs, Extension Professor of Agronomy, University of Wisconsin

Plans for Future Meetings Committee

Mr. T. F. Yost, State Weed Supervisor, Kansas State Board of Agriculture, (Chairman)
Dr. L. M. Stahler, Associate Agronomist, U. S. Department of Agriculture
Dr. C. J. Willard, Associate Agronomist, Ohio State University
Mr. C. H. Schrader, Director, Weed and Seed Division, Minnesota Department of Agriculture, Dairy, and Food.
Mr. E. P. Sylwester, Extension Botanist, Iowa State College.
Mr. W. L. Klatt, State Weed Supervisor, Nebraska Department of Agriculture and Inspection.
Mr. J. R. Fleetwood, Extension Specialist in Farm Crops, University if Missouri

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Mr. Howard: Thank you, gentlemen. We will now hear a talk by Mr. Schrader on the purpose of the conference.

PURPOSE OF THE WEED CONFERENCE

Mr. C. H. Schrader
Director, Weed and Seed Division
Minnesota Department of Agriculture, Dairy, and Food

If the weed losses in the United States estimated by the United States Chamber of Commerce were three billions of dollars in 1930, we can easily suspect that they are now nearer five billions of dollars, or an average of more than one hundred million dollars per state, because it is very doubtful if weed control throughout the United States is keeping pace with the increase of weeds and the losses they cause.

But it is not my purpose to discuss weed losses with you, who know more about your states than I do. I want only to suggest that losses from weeds are probably so large that we would be amazed if we could measure them accurately.

Too long have too many of the leaders in agricultural education and research drifted along under the impression that our so-called good, ordinary, farming practices were controlling weeds. We know that this is not generally true. As a result, special weed regulatory and control agencies have been created in many states.

After struggling along in Minnesota since 1872 when our first weed control law was created, for fifty years, with weed control by local public officials, we realized that we were not getting anywhere in halting the spread of weeds. Then the state was made the overall administrative and enforcement agency in weed control, with the actual inspection and control responsibilities still resting on the local officials. Now, after 23 years of state administration of weed regulatory work, during which an earnest but not very successful effort was made, we are still not convinced that we are gaining on the weeds nor even holding our own. The principal hindrances seem to have been lack of adequate finances, limited and inadequately equipped and trained workers, together with administrative and statutory impediments and lack of vision. We wonder if this may not be the experience of other states.

In the face of such a situation, the weed conference of 1938 at Des Moines, Iowa, was a good start and stimulated a more unified interest in our common problems of weed control. Since that conference, a number of us felt so strongly the need of more such gatherings that this conference was arranged with the loyal help and support of men from many states, mainly from Kansas and Nebraska.

NOW, JUST WHY ARE WE HERE? We have a common problem. The basic principles of weed control are much the same everywhere.

After over twenty years of regulatory experience in Minnesota, we have come firmly to the belief that weed control is a much more important, a much longer, and a much more complicated and difficult problem than was believed at first, and which many people still are not ready to admit.

We do not wish to dampen the enthusiasm of those states which are now embarking on a regulatory weed program, but we believe that if nothing more should come of this conference than to reveal or to uncover, in its stark reality, the seriousness of the weed problem and the nature and difficulty of our job, and the necessity of prompt and adequate action, IT WILL BE WELL WORTH WHILE!

There is hardly a state or a locality that cannot contribute something constructive and helpful to the solution of the problem facing us. While our problems are much the same basically, we are attacking them as 12 to 14 or more separate states, with 35 to 50 only partially coordinated agencies, largely planned, organized, financed and equipped differently, with staffs varying widely in size and ability of workers, and effectiveness of administration.

If our laws hinder what we know we should be doing, let us be courageous and try to get them changed. Many of us have a general, though sometimes vague, idea of what our neighboring states are trying to do. Many of our laws and programs look well on paper, but how well are they working out? Perhaps you can tell us and prevent us from making any mistakes which may lie ahead of us should we follow a plan which you may have attempted.

Weed regulatory work has two principal parts: PREVENTION, mainly through seed control and other effective means; and CURE, through control and eradication methods by proper tillage and use of chemicals and other materials. Both may result from voluntary action or legal compulsion. Each of these parts has three main phases: research, the basis of all adequate and dependable control; education to enlighten the public as to losses from weeds, the necessity for adequate control and how it may be accomplished effectively and economically- this duty rests squarely on our educational agencies, the schools and extension services. The third phase is law enforcement which is clearly the duty of regulatory agencies.

Now, in the light of nearly 20 years experience in county agent, extension agronomy, and regulatory work, I ask you this question frankly and seriously; would there be much left for the regulatory agencies to do if research and education had done their jobs when and as they should have been done? I am reminded of the situation in one state where the county agents were told to leave weed control alone. A few courageous and perhaps I should say foolhardy county agents, in spite of the instructions, but backed by the insistence of their farmers, did some good weed work. One created and used the Redwood Plan of Weed Control so effectively it has been used in many other places. These county agents were called on the carpet, for they had refused to sit idly by and see the weeds spread and take the farms just because those in authority did not recognize the growing weed menace or were afraid to face it.

But it was too late to quiet what these county agents had started. The common enemy, weeds, had been exposed and its threat to agriculture measured. The call to arms came from the farmers themselves through their county agents. The result was a general sectional weed conference at Windom, Minnesota on December 18, 1934, which some of you may have attended. Then followed a boost in intensity of interest and activity in weed control in our state and perhaps in some of your states. Out of it came one of the most valuable features of our weed program - state quarantines; and by the cooperation and influence of a number of you, weed-minded states, came a weed unit in the United States Department of Agriculture. The conference had pooled the interest and effort into a united front.

Much more research in weed control seems to be needed. What are you doing in your state? How can states get together and cooperate to cover the field and yet avoid unnecessary duplication in major and basic research over area of similar conditions and weeds? We of course recognize the work of the United States Department of Agriculture whose weed program, good as it is, perhaps should be greatly expanded This conference can help find the answer.

Then there are the purely state and local weed research problems. In our state, three weeds promise to cause us serious difficulty and great economic loss if not halted soon, especially in our northeast counties. These are: oxeye daisy, meadow butter-cup, and ragweed; the first two because they are destroying the pastures and meadows, and the latter because the few remaining hay fever havens of the state are threatened with extinction soon. This may interest some of you who like to hunt and fish in these hay fever-free areas. Austrian field cress appears in some ways to be much more difficult of control than any other deeply-rooted perennial in our state. We did not fully appreciate this until what was a small infestation on one farm ten or twelve years ago has grown into hundreds of acres on many farms because accepted methods of control have not proven to be effective. What is your experience?

How extensive should our educational work be? How should it be done, and who should do it? In the final analysis, it becomes the duty of the regulatory agencies if the educational agencies do not meet the problem adequately.

Out of this conference can come plans for a better division of the duties of weed control, a better synchronization of the efforts put forth by research, educational, and law enforcement agencies, and a speeding up and intensifying of research and education where these are lagging behind public and regulatory needs.

In several states, weed regulatory responsibility rests on local administrative officials or their appointees (of the townships, municipalities, and, in some cases, counties.) Theoretically, this is where it belongs, but practically it is not very successful here unless it is closely supervised by one or more higher but closely associated levels of authority, such as county or state. Fifty years of statutory weed control in Minnesota by local governments alone proved to be ineffective. As a result, twenty three years ago the state was charged with the responsibility of administering weed control through the local weed officials, who were to continue the actual enforcement of the law. We are now thoroughly convinced that while there has been distinct and worthwhile improvement in weed control through state administration of the law, the state government is too far from the actual, local weed problems to correct the weaknesses of local weed control, without too great a financial burden on the state. District supervisory weed and seed inspection, at state expense, is now being tried. There has also been developing another level of supervisory inspection, the county, which is now partly on a cooperative basis between states, counties, and townships in more than 50 counties. This will eventually be carried on entirely at county expense, with state participation in selection of personnel of suitable qualifications and adequate supervision by the state.

What is a suitable and adequate system of weed regulatory work for a state? A large system of state inspection without many active local inspectors close to the actual problems does not seem to control weeds. On the other hand, many local inspectors without adequate, qualified, close supervision of a county, district or state level are not effective in meeting the problem. To be sure, by either method we can do a lot of good work and spend a lot of money, but in spite of these the weeds keep gaining on us.

Another problem facing us is the personnel of our regulatory departments. Weed control involves the close cooperation and synchronization of work of research, educational, and regulatory agencies. They must work together harmoniously and effectively, and understand one another.

Research and education, because of the wisdom and foresight of their founders and directors, from tradition, experience, favorable public sentiment, administrative insistence and consent, and even legal requirements, and protection from political influence have largely enjoyed the benefit of the services of highly trained workers who were selected on the basis of their ability and were protected against political and other disturbing influences.

Regulatory agencies which stand closer to, more directly under, and subject to the shifting forces of changes in government are not so fortunate. They are constantly subject to the scrutiny and critical eye of research and educational workers with whom they must cooperate. If regulatory workers do not measure up to the high educational, scientific, technical, and general ability standards expected of them, we must remember that they are as good as legislation, administrative policy, and financial limitations permit or require.

Is it a proper criterion to assume that being a farmer qualifies one for dependable and satisfactory supervisory weed regulatory and control duties? Should a state weed inspector be as well trained for his job as a county agent is for his? In many states, they work closely together on weed control, in which cases the weed inspector ought to know more about the whole weed problem than the county agent. In too many cases, this is not true. Should not the supervisory weed inspector bring to the weed problem technical, fundamental knowledge of weeds, their identification, nature, habits, and control to supplement the more practical knowledge and experience of the farmer, the local weed inspector, and the county agent, in place of having only a duplication of their knowledge or as in many cases, less knowledge of the problem.

The American Association of Seed Analysts, from years of experience, has developed a set of high standards for seed laboratory workers, which is a basis of the excellent, uniform, and dependable work of practically all official laboratories in the United States and Canada. Perhaps this conference can start 'the ball rolling' to bring about equally high standards for the personnels of regulatory and control agencies of the higher levels of administration.

The purpose of this conference is to give an opportunity for the exchange of ideas, plans, methods of control, successes and failures in meeting the weed problem by means of which we can all learn something worthwhile.

I sincerely hope that those of you from states of longer and wider experience will speak freely and tell us of your plans, methods, and successes as well as your failures and difficulties; and that those of you from states just embarking on weed regulatory programs will be able to profit from what you learn so that you may avoid some of the mistakes the rest of us have made.

Together, by this and other conferences, we should be able to plan, motivate, and guide weed control along a common battlefront, with intensity and methods fitted to our special needs against our common enemy - weeds.

Mr. Howard: Thank you Mr. Schrader. I am sure your remarks show firsthand knowledge of the weed problems. The state reports will be given now in the order they appear on the program. We will first hear from the state of Illinois.

ILLINOIS

Dr. R. F. Fuelleman
Assistant Professor, Crop Production
University of Illinois

The seed and weed laws of Illinois are available to all interested persons and need no explanation here. Amendments have been made from time to time to these laws, some within the last year or two. Under the seed law the following are listed as primary noxious weeds: Canada thistle, perennial sow thistle, field bindweed, leafy spurge, and hoary cress. The secondary noxious weed list includes curled dock, wild garlic, dodders, bull nettle, buckhorn, quack grass, wild mustard, Johnson grass, oxeye daisy and wild carrot. Two of these in particular are cause for serious concern, although all of these species are serious within the limits of their soil and climatic adaptation. These two are field bindweed and Johnson grass.

The weed law confines noxious weeds to the same species identified above as primary noxious weeds. The law provides for appointment and lists the duties of noxious weed commissioners appointed by the various municipal, township, road district or county boards, auditors, etc. Under conditions as they exist today it seems that the seed and weed laws are effective at the upper levels of administration, namely, the state and district levels. However they tend to break down at the lower levels where the really effective work is required for control and eradication. State and county highway departments do an excellent job in keeping weeds under control; township road weed control is ineffective. Much of this can be ascribed to shortages of labor and machinery. Our principal railroad systems are making determined efforts for effective weed control. Some of our oil well companies are attempting control of weeds on pumping sights. Their objectives are three-fold elimination of fire hazards, economy, and appearance. One company official states that it costs about $90.00 a year to cut weeds on an individual pump site. A wide range of chemicals have been tried. Most of these chemicals are within the group of non-poisonous, non-inflammable group. During this past season many thousands of pounds of borax were used.

From the standpoint of soils, Illinois is divided roughly in half. The northern half comprises our corn-belt land. Field bindweed is a rather serious weed in some areas of this part of the state. During recent years weed research projects in this part of the state have been carried out on field bindweed in particular. In addition to control methods by cultivation and chemicals, the station workers under the leadership of Dr. L. V. Sherwood have attempted to evolve the most effective crop rotation, consistent with economy and effectiveness. The results of this work are in press at present. When published, copies will be available to all of you upon request.

Quack grass is rather generally spread over northern Illinois. Perennial sow thistle is most serious in some of the northeastern counties, while Canada thistle is most serious in the northern third of the state, although it is rather widespread.

In southern Illinois Andropogon virginicus (broom sedge) is a widespread nuisance that can be easily controlled by cultivation, however it becomes a problem on sloping land. We have under way at the present time a pasture weed clipping project that we hope will give us data on the effectiveness and cost of this type of control. The most potentially dangerous weed in southern Illinois is Johnson grass. It has been most serious along the bottom lands of the Wabash, Ohio, and the Mississippi River bottom lands as far north as the confluence of the Illinois and Mississippi Rivers. Control and eradication is difficult in many cases because of flooding and reinfestation. Johnson grass has been most serious on some of the best land in southern Illinois.

It is our opinion that effective weed control and eradication is dependant upon the organization and education of the individual farmers through any and all means available. Our county farm advisors have so many duties and tasks that it is difficult to see how they can give much time to weed control. It is difficult to see why weed eradication and control do not have a larger place in our educational programs. Professor Shawl may have some further information.

Professor Shawl: The development as far as weed control is concerned, is practically out because most all of our men are in the service and we don't have enough staff to continue this type of work. I don't think there will be much done until our men return to take it up.

INDIANA
Mr. Oliver C. Lee
Extension Botanist
Purdue University

Our weed problems are similar to those of Illinois. We have about the same weeds to contend with and to fight. Field bindweed, quack grass, Canada thistle, and Johnson grass are the most dangerous weeds we have and therefore have received the most attention. We also have a problem with wild garlic and wild onion and a host of annual weeds.

Indiana does not have a rigid weed control law. There are two laws applying to weeds at present. One requires the cutting of Canada thistles to prevent the scattering of seed by the wind, the other applies to weeds growing along highways. Weeds along highways are cut between the first of August and the first of October. The Canada thistle law is not always enforced. Enforcement is up to the township trustee. Where thistles are not too numerous, enforcement of the law is helping to check the spread of Canada thistle.

The Indiana seed law has helped to prevent the spread of noxious weed seeds through crop seeds. Under this law, twenty weeds are declared noxious. Six of them - Canada thistle, field bindweed, quack grass, perennial sow thistle, wild garlic and Johnson grass are "Primary Noxious Weeds." Bitter wintercress, corn cockle, bracted plantain, buckhorn plantain, common plantain, curled dock, dodder, field peppergrass, horse nettle, mustard, oxeye daisy, red sorrel and wild carrot are "Secondary Noxious Weeds."

It is unlawful to sell agricultural seed, for seeding purposes, that contain any seeds of the six primary noxious weeds, more than one-half of one per cent of secondary noxious weed seeds, and more than three per cent of weed seeds of any kind noxious or otherwise. Seed dealers and farmers who advertise having seed for sale

are required to tag seed in full weight. The tag carries such information as purity, germination, weed seed content, where grown, and the number of secondary noxious weed seeds per pound of crop seed.

The need for more research is evident. We do not know enough about the habits of many weeds. An attempt has been made to work out practical and effective methods of control and eradication of the most serious weeds. Field bindweed and Johnson grass have been eradicated on several farms by both chemicals and by cultivation. Chemicals have played an important part in our control program because most of the infestations of bindweed, and in some areas Johnson grass, are confined to small patches where it is practical to use chemicals. I believe the feeling of most Indiana farm people is that they are not ready for compulsory weed control. The postwar weed control program should be an educational one, pointing out weed losses, keeping farmers informed regarding new and dangerous weeds that may be introduced, and encouraging the adoption of the most practical and effective methods of control. An attempt has been made through meetings and publicity as well as in leaflets published to point out that weed control is a community job and only with everyone doing their part can weed losses be reduced.

Meetings of this type certainly are well worthwhile and all of us interested in weed control should get a lot of good out of them.

IOWA

Mr. E. P. Sylwester
Extension Associate in Botany and Plant Pathology
Iowa State College

I should like very much to talk about our Iowa weed program. However, in accordance with the request, I am going to confine my remarks to the stipulations as outlined in the program. While this probably will not give you a complete picture of our weed work in Iowa, it will perhaps give you the essential points. These four points are (1) important provisions of the Iowa weed law, (2) action program, (3) progress and (4) advisable future changes in the weed law.

Important Provisions of the Iowa Weed Law.

The Iowa weed law classifies 17 weeds as noxious. This group is divided into 8 primary noxious and 9 secondary noxious weeds. The law tries to focus attention on our primary noxious weeds, all of which are perennials, reproducing by both roots and seeds. All of them have been brought into Iowa, none of them are native. In fact only one, horse nettle, is a native of the United States. The primary noxious weeds are Canada thistle, quack grass, perennial sow thistle, bindweed (or creeping jennie), horse nettle, leafy spurge, perennial peppergrass and Russian knapweed. In all our educational and control work we attempt to focus attention on our primary noxious weeds. Our nine secondary noxious weeds consist of 4 annuals, namely buttonweed, cocklebur, wild mustard, and puncture vine; one biennial, namely wild carrot and 4 perennials, namely buckhorn, sheep sorrel, sour dock, and smooth dock. While these are also very serious, they can in the main be controlled by good farming methods. The primary noxious weeds cannot be controlled by even very good farming operations. They can only be controlled by following special methods designed to eradicate them.

The second important point in our weed law is that weed control enforcement is vested in the county boards of supervisors and they must appoint "either a county weed commissioner, or one township weed commissioner for each township whose term or terms of office shall not exceed one year." While all counties appoint weed commissioners, only the ones who are appointing one man for a county, with such assistance as is necessary, are the counties who are making at all satisfactory progress in our battle against weeds. The county weed commissioner system has gained in popularity. It was in 1937 that the Iowa law gave the county boards of supervisors the choice between one man for every township, and one man for the entire county. We have found the latter system to be much more effective for reasons you all know.

Another point in our weed law which is quite important is that our State Secretary of Agriculture may cause areas of new weeds to be destroyed, the cost to be borne by the county. We hope this will serve to stop the spread of noxious weeds which are as yet not found in our state. If such a provision had been enforced years ago when bindweed and thistle were first coming in, our weed problem now would not be as serious as it is.

The board of county supervisors have authority to enforce weed control on all lands irrespective of ownership. Duly appointed weed commissioners have authority to enter upon any land and cause noxious weeds to be destroyed by the best known methods. Each owner of infested areas shall "cut, burn, or otherwise destroy in whatever manner is prescribed" any noxious weeds thereon to prevent them from coming to maturity. Enforcement of any eradication measures must be preceded by publication of such notices in the official newspapers of the county. This suffices for all cases except where the cost of eradication is over $25.00 in which case a registered notice must be sent. All loss incurred in destruction must be borne by the titled owner of the land.

I believe that the most important provision of our weed law is as follows: "The Board of Supervisors of each county, shall each year, upon recommendation of the weed commissioners, order a program of weed destruction to be followed by landowner, tenants, or both, which in five years may be expected to destroy and immediately keep under control any areas of primary noxious weeds." In other words the landowner or tenant or both have their choice of appropriate chemical methods or recommended smother crops (which we know by many experiments will successfully eradicate these weeds) but he must undertake control in this way. By adopting this program he may eradicate weeds at a profit; if he doesn't, enforcement measures can be utilized. In the counties where county weed commissioners have really taken advantage of this provision, and have gotten farmers to sign agreements based on the above, an have outlined the crops and procedures to be followed, very good results have been obtained. This provision is especially useful on large areas of noxious weeds where only smother crop methods are feasible. I hope that in the future all of our counties will have county weed commissioners who can take more advantage of this valuable clause.

Our seed law is modeled very closely after the Federal Seed Law. We feel that both our weed and seed laws are quite adequate to handle our weed problem if they were properly enforced. That is our big trouble now. County boards are often too indifferent or too lenient. We know there are two or three weaknesses in our weed law which we are trying to get corrected in the near future and which I will mention later. In the main, however, if county supervisory boards really are serious about enforcing our existing weed law they will find it very adequate in most respects.

Action Program

Our action program in Iowa is based on research, education, and law enforcement. I might say these three are inseparable. To omit one of these is to make the program incomplete. Research must discover the herbicides and determine the most effective application conditions. It must also determine the most effective smother crops. Education must bring these discoveries to the man with the problem and this is the function of education and particularly the Extension Service. The few who will not heed this educational advice and product of research, must, for the benefit of the many, be forced to undertake control measures for their own good as well as for the sake of surrounding adjacent areas. This is the function of law enforcement.

Our experimental work is carried on mainly at Cherokee by Dr. Bakke. The Extension Service also conducted numerous field demonstrations in various parts of the state which are experimental and demonstrative at the same time. We feel that as far as research is concerned, we have at least a nominal number of authoritative results in both chemicals and smother crops which apply to our entire state. We haven't solved all our weed problems, but we can meet a large number of them.

Our educational work in the Extension Service concerns itself about putting the results of our research into the hands of our County Extension Directors and lay people in the best possible ways. We certainly stress our educational program over our enforcement program--it must come first. The Extension specialist and County Extension Director using experiment station results spearhead this educational work. We conduct county and township meetings on weed control, conduct chemical and cultural smother crop demonstrations, talk at various types of meetings on weed control, sponsor weed exhibits at strategic well advertised public functions, sponsor weed surveys where necessary, cooperate with Vocational Agriculture instructors on weed meetings at night schools, give individual farmers help on weed problem areas, meet with county boards of supervisors and help iron out their weed problems, and help the duly appointed (usually county) weed commissioners on problem areas, smother crops, chemical control, and weed identification. We also supply bulletins, kodachrome slides, leaflets, forms, and publicity on weeds. Our County Extension Directors are really the ones on the firing line in our weed control program because it takes more than just one or two yearly visits of the Extension specialist to conduct a good weed program in the counties. Hence our County Extension Directors are vital cogs in our weed program.

Our experimental and educational program is supplemented by our enforcement program. I might state that the experimental and educational work is sponsored by the college and the enforcement work for both weed and seed law is sponsored by our State Department of Agriculture with whom we enjoy the most cordial relationships. If the county boards of supervisors are really intent on enforcing a good weed law, very few complaints need go to our Secretary of Agriculture, who is in reality our State Weed Commissioner. The law is explicit enough and broad enough to enable the supervisors and their duly authorized weed commissioners plenty of power to enforce the law. In the last three or four years our State Secretary of Agriculture has had to act as State Weed Commissioner only once, and that problem was settled in the interests of all concerned. In county weed eradication work it is very important to get the right man as weed commissioner. He must be willing to learn, fairly well acquainted with the people of the county, honest, have a good personality, be understanding, firm, tolerant, and patient. He must not be overbearing (in spite of his authority) hasty, partial or inclined to take excuses. I know it's hard to

get a man of this type at any time and especially at this time. Nevertheless since so much depends on the success of the county weed program, it is important to get a very good man for a county weed commissioner. Since a weed commissioner's worth increases from year to year, his job should be important enough to be beyond the scope of politics. While this is usually true, it is unfortunately not always the case. While there is always room for improvement, about half of our Iowa counties (about 50 out of 99) have made a beginning in a good weed control program.

Progress

Our present Iowa weed law gives the county supervisory boards the choice to appoint a weed commissioner for the entire county or one man for every township. About 50 percent of our 99 counties are at the present time employing a county weed commissioner. The rest appoint township weed commissioners. In 1935 we had no county weed commissioners. In 1936 there were nine, in 1937 there were 13, in 1938 there were 30, in 1939 there were 34, in 1940 there were 54, and in 1941 there were 59. At the present time there are 51 counties who are in reality operating on the county plan in spite of manpower shortages. These counties are really making much progress when you compare them to the counties where poor to indifferent results are being obtained under the out-moded township weed commissioner system. Eighty to ninety percent of our good farmers, whether tenants or owner operators, are in favor of increased education on weed control as well as of better law enforcement. Local landlords are also mostly cooperative. Our big trouble is with absentee landlords, although even there if the case is handled judiciously, we are making progress. But all education as well as law enforcement should have some rallying point in the county and that rallying point should be a good county weed commissioner. All of our educational work has stimulated weed control but educational work is better received and more popular in counties where good weed control systems are in operation, than in counties where such is not the case. We need more educational work on the use of chemicals and smother crops and on all phases of good seed as a bulwark against an ever-increasing weed problem. Even in our best counties where weed control is being pushed quite consistently and vigorously, there is room for improvement. In our other counties the need is urgent. We have made a lot of progress but the surface has merely been scratched. Much more needs to be done throughout the entire state.

Advisable Future Changes in Our Weed Law

While our weed law is very workable and can be made very effective, there are a few changes which if enacted would greatly enhance its usefulness. In the first place the appointment of a county weed commissioner should be made mandatory in all counties. This would eliminate the township weed commissioner system altogether. This should be a great help for increasing educational work as well as law enforcement. The township system just isn't standing up to requirements for reasons we all know. In the second place we need a special weed control fund for every county. The original weed law contained a financing clause but this was eliminated before the present law was passed. Now the cost of any weed control work is financed by the county general fund, and this in many instances is not sufficient to permit good weed control work. An "enabling" tax not to exceed a quarter mill on the assessed valuation in the county, would give the counties the privilege of raising such money as would be necessary to prosecute a good weed control program. This tax could be levied if necessary only by the counties who would wish to use it and the revenue go into a separate weed control fund. This would give the county a definite sum to institute a good program under the direction of a good competent weed commissioner. It costs money to institute and continue a good weed control program in the county -- but it costs agriculture, the county, and the farmer more

to keep the weeds. In the third place the Iowa weed law needs a "legalization" clause which will legalize the use of county (especially spraying and levelling) equipment for use on privately owned farms. Most counties, where good weed control programs are in force, are already making that equipment available to the farmer. Usually it is on a cost (plus depreciation) basis. They have had very good results with such arrangements but nevertheless it is being done without legalization. We need to make this procedure legal. In the fourth place our weed law needs a little simplification as to methods of assessing costs of destruction, definition of "tract of land", elimination of the penalty clause fining weed commissioners for non-performance of duties, and perhaps a little broader interpretation of the highway and road, as well as city lot problem of rank annual weeds constituting a traffic hazard or public nuisance. The above briefly are our major contemplated changes in our weed law at the next legislative session.

These are in brief the high points to the questions I mentioned at the beginning of this report. In research, extension, and law enforcement, we have made a good beginning. Law enforcement can go no faster than public opinion demands, warrants, or supports. For that reason we are attempting to keep our weed program in Iowa as balanced as possible. We have made a good beginning, but we have a long way to go. We must constantly seek to improve our research, extension teaching, and law enforcement if we are to succeed.

KANSAS

Mr. T. F. Yost
State Weed Supervisor
Kansas State Board of Agriculture

The present Kansas Noxious Weed Law was enacted in February of 1937. The important provisions of the Kansas law are as follows:

Important Provisions of Law

1. The law applies to only field bindweed, Convolvulous arvensis, which is the states worst weed. Other weeds may be added at any future time by legislative action.

2. It requires all landowners to eradicate all field bindweed found to exist on highways and railroads, in cities and townships, as well as on city property, and on farms. City officials are designated as responsible action and enforcement officials pertaining to bindweed inside of city limits and county commissioners are the responsible action and enforcement officials outside of city boundaries.

3. The State Board of Agriculture is designated as the official state agency responsible for action and enforcement as well as being empowered to adopt official methods, rules, and regulations to facilitate the practical operation of the law.

4. The law permits county commissioners and city officials to employ jointly or separately a weed supervisor to carry out their responsibilities, whose duties are to cooperate with landowners and any agency interested in eradication of bindweed on their lands.

5. The law provides that the state shall pay not more than 25 per cent of the weed supervisors salary.

6. The Secretary of the State Board of Agriculture or his representative shall confer with officials or municipalities and other agencies to work out yearly goals and a program of action which must be approved by him.

7. The county assessor is required to annually report the extent of bindweed to county, city, and township officials as a basis for making the necessary tax levy to support the bindweed activities for the ensuing year.

8. The Board of County Commissioners and city officials are required to enforce the law in their respective jurisdiction, after due and proper legal notice has been given landowner in which case actual costs are assessed against the land and collected as other taxes. The state office has recommended the use of enforcement procedure only after adequate educational work has been done and only then where joining landowners are involved.

9. Proper county or city officials may purchase and operate tillage or chemical equipment and operate same in cooperation with landowners on an actual cost basis.

10. The county commissioners are required to provide state approved chemicals to landowners at one-half actual cost. All counties make a uniform charge of four cents per pound, which is slightly more than half price.

11. The law has a penalty section which provides for a fine of fifty to five hundred dollars for violation.

Since the original enactment of the law the State Board has adopted regulations including six sections dealing with official methods of treatment and three sections pertaining to enforcement.

Plans and Set-Up of Action Program

State Office Set-Up: The state office set-up consists of a state weed supervisor, an assistant state supervisor, and one office clerk. The state supervisor assumes the responsibility of handling most county program activities, as well as all work with railroads, state highways, and such things as the annual statewide meetings and all regional meetings. He also handles all ofice work including reports from counties, cities, townships, railroads, state institutions and state highways in the state. He handles all correspondence, publicity, radio talks, and preparation of all forms and printed material. Quarterly reports are made to the State Board of Agriculture and a detailed annual report is compiled from county reports. In addition, the state supervisor tries to meet with 105 county officials three times each year. The first trip consists of a program planning meeting which usually requires from two to three hours per county. In this work, two counties per day are reached. During June and July it is necessary to meet with each Board of County Commissioners for the purpose of setting up and agreeing on budgetary tax requirements of the county weed program for the ensuing year. These figures are placed in the county tax budget and a special levy is assessed to raise the amount required, which is placed into a special noxious weed fund. In this work it is possible to meet with five counties per day. During the late summer and fall months, the state supervisor or his assistant attend a half day county bindweed tour, at which time samples of all type of work are visited and discussed. In addition to

seeing typical cultivation and chemical work, one stop is made to see and discuss one of the other bad weeds, another stop to see the county cultivation outfit in operation, and another stop for the purpose of demonstrating proper technique in treatment of a bindweed patch and proper care, adjustment and operation of the mechanical spreader.

The duties of the assistant supervisor are primarily to handle the program with cities of which we have 625 in the state that are incorporated. Of this number, about one-half either have no bindweed or it has all been treated. The assistant meets with the remaining 300 cities for the purpose of planning the yearly program. In this work usually four cities are handled daily during the winter and spring months. During the summer and fall months, the assistant meets with about 200 to 250 cities on an inspection tour, requiring about 1½ hours per city. In this work it is possible to reach four cities per day. In addition, the assistant state supervisor helps the state supervisor in conducting county inspection tours, in conducting regional and state meetings, assisting new supervisors in getting started, inspecting the work of state institutions, and other jobs of an emergency nature.

The state appropriation made to handle weed work was $17,000 yearly for the last biennium. Of this amount, about $7,000 was paid toward the salary of county weed supervisors at the rate of $10 per month for actual days worked. The remaining $10,000 was paid for salaries of state supervisor, assistant supervisor and office secretary, as well as travel and office expenses.

Local Set-Up: The Kansas program is based mainly on the county set-up, which is under the supervision of the county commissioners who employ a county weed supervisor and who is in full charge of most if not all of the weed activities in the county subject to the approval of the Board of County Commissioners of the 105 counties in the state. The number of counties having county weed supervisors since the inauguration of the program has been as follows:

1938	- 54	Counties	1942	- 102	Counties
1939	- 87	"	1943	- 101	"
1940	- 99	"	1944	- 98	"
1941	- 102	"			

During the last two war-time years, there has been a slight reduction in the number of counties having weed supervisors due to manpower shortage and inability of hiring qualified supervisors.

The work of the county weed supervisor generally involves the following activities: (a) Calling on individual landowners who have bindweed, for the purpose of mapping and surveying bindweed situation and confering with landowner on proper procedure for treatment of his bindweed during current year and assist in planning long-time program where desired. (b) Checking county and township highways for purpose of locating and mapping new and untreated bindweed areas for treatment during the current year. (c) Checking and retreating all farm bindweed infestations which received original treatment in former years. (d) Checking all areas under regular cultivation three times during season---in May, July, and October, and make record of condition of bindweed at time of inspection and talk to operator if work is behind schedule or otherwise improperly done. (e) In counties which operate county-owned cultivation outfits, contracts must be negotiated between the landowner and county and outfit must be started soon after bindweed starts growing and must

be kept in good running order and in actual operation each two weeks covering all bindweed under contract. Outfit must be checked frequently to see that everything is going smoothly and that operator is on the job. (f) At the proper time chemically treat and retreat bindweed on highways. (g) Contact proper railroad officials concerning their bindweed, order needed chemical, and cooperate with railroad companies in supervising proper application of chemical. (h) Contact proper state highway officials and cooperate by locating, marking and mapping all bindweed patches on their road, and arrange to be with state treating crew when they are in his county. In 25 counties the county weed supervisors this year treated the bindweed for the State Highway Department on an actual cost basis. (i) Chemically treat small infestations for landowners during fall months and make accurate record of all such work. (j) Cooperate with cities in surveying their bindweed and applying their chlorate. (k) During the year check all old cultivation and chemical cases on the eradication list and advise landowners on the dangers of the seedling problems and apply chemical spot treatment where advisable. (l) Carefully clean, paint and store all equipment. (m) Attend one annual statewide and two state conducted regional meetings. (n) Plan and attend three county meetings and two meetings in each city when state representative comes to county. (o) Make monthly report and annual report for state and county officials. (p) Bring file records and history records up to date on all eradication activities during season. (q) Miscellaneous work would consist of contacting absentee landowners by correspondence, mailing circular letters and printed material, collecting unpaid accounts, serving legal notices and many other jobs too numerous to mention.

In addition to receiving their sodium chlorate at half price, all but two counties own dry mechanical spreaders and treat the small patches for landowners at 1 cent per pound of chlorate used. During the past year 46 counties have operated 54 county-owned cultivation outfits who cultivate bindweed for landowners on an actual cost basis. From this you may see that our program is largely based on rendering cooperation and service to both individuals and municipalities.

Each county weed file has a complete case file folder for each landowner who is on the bindweed list. These are filed either alphabetically by townships or by legal description of land. In each county weed office there is a history sheet for each landowner having bindweed. This sheet gives a complete historical record of all weed work done on his farm since 1938 to date. In our program, we insist that a complete and detailed record must be kept on all work done.

Progress Made in Six Years (Not Including 1944)

Even though the Kansas law was enacted in 1937, actual eradication work was not begun until the spring of 1938. Our weed program has now been in progress seven years. We are able to report only on six years' work as the reports for 1944 are just beginning to come in.

Bindweed Situation in State. Completed county reports at the close of 1943 added a total of 1,567 new farms on record showing bindweed, making a total of 46,859 farms on record in the state as having bindweed since 1937. These farms show a total of 200,402 acres of bindweed, including that which is listed as eradicated, that under treatment, and that which has never been under treatment. These figures do not include bindweed in cities, on highways, on railroads, nor that which exists but is not on record.

Cultivation Work and Complete Eradication (On Farms Only)

	First Year		Second Year		Eradicated	
Year	Farms	Acres	Farms	Acres	Farms	Acres
1938	2,556	22,303	xxx	xxx	133	995
1939	5,374	35,033	2,073	15,013	839	7,104
1940	3,439	20,637	4,884	30,764	1,885	12,396
1941	3,430	24,226	5,188	29,960	1,901	11,026
1942	3,083	23,212	4,005	27,664	1,534	8,457
1943	1,560	12,795	3,169	22,055	1,336	9,375

During the last five years, 1939 to 1943 inclusive, bindweed has been eradicated at an average rate of about ten thousand acres per year in the state, by cultivation only. The total acreage eradicated by cultivation as shown in the last column is 49,353, which is 25 per cent of all reported bindweed in the state. The figures in the table include work done by landowners and also that by county-owned equipment. During 1942 county-owned equipment did 16 per cent of all the bindweed cultivation work in the state. This table will show that labor shortage on farms and other factors in 1943 reduced the acreage of bindweed under cultivation to about 70 per cent of previous years and the number of landowners cooperating in 1943 was reduced to 66 per cent under the previous year.

Bindweed Eradicated and Under Treatment (On Farms Only)

(Cultivation and Chemical)

	No. Patches	No. Farms	Acres	
A. ERADICATED:				
1. By Cultivation	xxx	xxx	49,353	
2. By Chlorate	30,613	xxx	3,660	
3. By Special Methods	2,832	xxx	577	
4. Total Eradicated	33,445	xxx	53,390	
B. UNDER TREATMENT:				
1. By Cultivation	xxx	3,395	25,464	
2. By Chemicals: 1943	11,378	4,218	2,000	(Est.)
3. 1938 - 1942 (Incl.)	19,791	xxx	4,000	(Est.)
TOTAL	64,614	xxx	85,054	

This table gives a comprehensive picture of how landowners are cooperating in the eradication of bindweed on their land. The number of non-cooperators is gradually decreasing each year. Those unclassified are due to inability of county to furnish chlorate and inability of supervisor to see all landowners and therefore properly classify them. Landowners who cooperated in years prior to 1943 but who still have untreated bindweed have been classed as non-cooperators if they did not use state approved chemicals for original treatment or cultivate in an approved manner. *Almost one-third of the landowners in the state having bindweed are included under No. 1.

Bindweed Treated On County Highway System (1938 - 1943)

61 counties have treated 100 per cent
25 counties have treated 90 - 100 per cent
19 counties have treated under 90 per cent

	1940	1941	1942	1943
Pounds sodium chlorate used.....	178,241	86,367	57,302	85,003
Tons salt used.....	1,353	2,077	1,811	1,759

There are 17,625 miles of county maintained highways in Kansas. Most counties have done an excellent job of taking care of the bindweed on all county lands, including the county highway system. A few have considerable work yet to do. This is mostly in the heavier infested counties. Most counties have chosen to use some salt for bindweed on highways and on non-agricultural lands. We consider salt as the best chemical for highways because of its more permanent effect. The effect of sodium chlorate will wear out in three to four years, after which the bindweed seeds in the soil will again start a new stand of bindweed. The use of salt has not increased during the past three years due mainly to manpower shortage. Fourteen counties cooperated with the State Highway Department in treating bindweed on state highways in 1943 and 25 counties in 1944.

County Owned Cultivation Outfits (1938 - 1943)

Year	No. Outfits
1938	6
1939	6
1940	7
1941	8
1942	36
1943	39
1944	55

No. counties with outfits.....	1943	39
No. new counties operating outfits in.....	1944	7
No. outfits operated.....	1944	54
No. farms worked on.....	1943	1,088
Acres bindweed cultivated.....	1943	5,686

Seven years of experience in ownership and operation of county bindweed cultivation equipment has proved that this is a practical procedure in the conduct of the Kansas noxious weed law and program. There are various reasons why counties need such equipment: (a) to cooperate with absentee and other landowners who cannot do their own work (especially during war period) and (b) to enforce the law where landowners fail to cooperate and thereby protect adjoining landowners. It is anticipated that the number of counties purchasing and operating outfits will increase rapidly as soon as the machinery and manpower supply is again normal. In Kansas all of this work is done on a voluntary contract and on an actual cost basis. This places no additional burden on the taxpayer. If the landowner fails to pay for the work, it is charged to his taxes.

Tax Funds Budgeted and Spent

Year	Tax Funds Budgeted by Counties	Total Expenditures	Net Expenditures After Deducting Reimbursements	Funds Budgeted by Cities*	Funds Budgeted by Townships*
1940	387,666	345,874	238,106	51,000	76,000
1941	499,684	328,713	226,196	107,000	76,000
1942	447,947	365,813	271,332	100,000	91,000
1943	461,115	324,998	200,242	87,000	65,000

*Neither total nor net expenditure figures are available.

The entire cost of operating the Kansas weed program is based on the budgeting, levying, and expending of public tax funds. Separate levies and expenditures are necessary by counties, cities and townships. The aggregate annual amount of taxes budgeted by all counties during the past four years has varied from $387,000 to $500,000. This does not include the amount budgeted by cities, which usually is in the neighborhood of $100,000 and the amount by townships is usually in the neighborhood of $75,000. The amount of net expenditures by all counties during the past four years has varied from $200,000 in 1943 to $271,332 in 1942. The net expenditures are arrived at after reimbursements have been deducted from the gross expenditure. The reimbursements are derived from the sale of chemicals to farmers, railroads, and city property owners at half price and to city officials for city property and townships at full price, applying chlorate for landowners at 1 cent per pound and for cultivation work done at actual cost.

Proposed Changes to Present Law

In our opinion there are two important and distinct phases of a good and adequate weed law. These may be referred to as the prevention phase and the cure or eradication phase.

The Kansas law was designed to handle only this latter phase of our weed problem. We feel that our law and set-up is well designed to handle the eradication and control work. We do, however, feel that after seven years of experience in conducting an extensive program to eradicate, that we are handling only half of the problem and probably the half which is least important. I am personally convinced that prevention is probably more important than the cure.

Our law and program have made excellent progress since 1937, when the legislature enacted the present weed law. The various agencies have given excellent cooperation in carrying out a practical program of procedure for eradication as recommended by the State Board of Agriculture. After seven years' work, records show that one-half of the bindweed acreage in the state is either eradicated or under treatment and 75 per cent of the landowners in the state having bindweed are participating in the program. In spite of the splendid progress made during the first seven years, it must be recognized, however, that the program is working on an uphill grade because the present law has no provision to reduce or control in any manner the spread of bindweed. Seven years of experience has shown that there are several weak spots in the law which should be reinforced in order to speed up eradication work and thereby reduce the expense to the taxpayers as soon as possible. There are several changes and additions that should be made to the present law. These changes may be added to the present law without actually increasing the cost of conducting the present weed program but will materially decrease the cost of eradication to the landowners and to all taxpayers in future years. Some of the changes needed are as follows:

Feed Grain, Rough Feed. It should be unlawful to sell, barter or give away feed grain or rough feed which is infested with seeds of bad weeds unless the seeds are destroyed so they will not grow. It has recently been found that Kansas is being used as a dumping ground for infested feed coming in from other states where such feeds have been made unsalable by legislative action. There is no more justification for selling feed infested with bindweed seeds than there is for selling infested farm seed. It has been proved by experience and by research that seeds of noxious weeds will pass through the digestive tract of livestock with their power to germinate and grow reduced but very little. Small grains, such as oats, barley, and wheat, are often infested with weed seeds and are used extensively as feed grains. Rough feed such as silage, straw, clover, lespedeza and alfalfa hays, and often stalk or bundle feed are infested with undesirable weeds. Such feed should be made unsalable without first having been processed to destroy the weed seeds, unless it is fed on the same farm where it was grown. Few farmers would knowingly buy such products for feeding purposes on their own land. Such feed should be handled by (a) feeding on land where it was grown or (b) processing to destroy the bad weed seeds before selling or by selling to a commercial processor. Many farmers would prefer to see feed rot or burn rather than feed it or have it fed on their land free from noxious weeds. It should be permissible for a grower to sell infested feed to a feed mixer or commercial processor.

Combining and Threshing. Threshing and the use of combines and field ensilage cutters are some of the most effective ways of spreading the seeds of bad weeds. The practice of custom combining and field cutting of ensilage has increased rapidly during the past several years. Most operators of combines and field ensilage cutters know little about spreading weeds to fields which have never been infested and many care less. Many combines doing custom work in the state are owned and operated by out-of-state owners. A good weed law should provide requirement for the proper cleaning of equipment before entering state and before moving from infested fields. Nebraska has had such a provision in their state weed law for the past seven years, and they claim it is doing much good. Cleaning threshers and combines can be helped by (a) running machine empty for three to five minutes at alternate slow and fast speed, (b) blowing or sweeping off machine, (c) saving first few bushels of grain from the next run for processing as feed.

Proper Disposal of Screenings. Screenings and offal from mills, elevators, seed and feed stores are frequently mixed into and sold as other feeds. Most screenings from large establishments are sold to large feed processors, where the weed seeds are destroyed by processing with a hammermill before being mixed with feeds. There are, however, a large number of small millers, elevator operators, seed and feed stores who do not have enough screenings to sell for processing to advantage and who dispose of them by mixing (without processing) in other feeds which are sold to unsuspecting people. Such a procedure should not be permitted. It should be unlawful for any person or corporation to sell, barter, give away or otherwise dispose of screenings or other offal without it first being processed to destroy all viable weed seeds.

Nursery Stock, Sod and Soil. The selling of weed-infested nursery stock is a common practice and has caused the starting of bad weeds such as bindweed on many private lawns and public grounds. In some cases infested nursery stock is brought into the state and sold through nursery dealers, stores, etc. Infested sod has been sold for landscaping purposes. At the present time the practice of selling infested nursery stock, sod and soil is not prohibited by law and the innocent buyer has no protection. The law to force eradication is largely defected by such activities.

Other Needed Changes. Our law also needs to grant proper officials authority to enter on property at all reasonable times for the purpose of checking compliance with the weed law. Our law needs further amending so as to include some of our other serious weeds such as Russian knapweed and hoary cress. We are not ready at this time to include any of a dozen other bad weeds in our state on a compulsory basis because proper and adequate research has not been done to establish effective recommended procedure for treatment. We also plan revision of our law so that it will permit township boards to purchase and operate cultivation equipment for their landowners on an actual cost basis.

In closing, we would like to say that after seven years of operating an extensive and intensive weed eradication program, that the two most serious problems confronting weed work in Kansas are (a) the seedling or reinfestation problem and (b) the soil erosion problem. In this connection we feel that these two serious problems must receive the active support of all research agencies. Unless we can find a reasonably good method of competing with these two problems, weed work will be working at a serious disadvantage and on an uphill grade for all time to come.

Mr. J. C. Mohler, Secretary of the Kansas State Board of Agriculture, has asked me to convey his sincere regrets for not being able to attend this conference and further states that he will make every effort to attend next year.

MICHIGAN

Mr. Chas. A. Stahl
Director, Division of Seeds
State Department of Agriculture

I have no report. I understand that the college extension service is to have a representative here, and he can no doubt give you a report.

We have no weed program effective in Michigan at the present time. We do have a weed law, but it provides that the counties "may" appoint a weed commissioner. No county has appointed a commissioner so far, so our weed program is not very active. Some people think our weed law is just a dead issue.

MINNESOTA

Mr. Bernard Swenson
Deputy Commissioner
State Department of Agriculture, Dairy, and Food

I very much regret that Commissioner Trovatten is unable to be here to report on the progress of weed control work in the State of Minnesota. I haven't a prepared paper so my remarks, therefore, will be quite brief.

When Mr. Schrader, who is in charge of the Weed and Seed Division in our department in Minnesota, spoke to you this morning, he indicated that this problem divides itself into three general phases, namely: Education, Control and Research. As in the familiar quotation of scripture on faith, hope, and charity or love, wherein it is indicated that the greatest of these is the latter, love, so also in the problem of weed control the most important of the three phases above mentioned is, in my opinion, research. Undoubtedly, education, bringing to the attention of the farmers and the public generally the problem of weed infestations as they may exist in any given locality, necessarily precedes the enactment of weed control legislation. Notwithstanding a long and ardent program of education on weed identification and control, many of our producers and the general public are still not familiar with, nor able to identify many of our so-called "primary noxious weeds." There is the incident of the farmer's wife, who would not let her husband attend a local weed meeting because she did not know who this lady, "Creeping Jenny" was, but that so far as she was concerned, he was going to stay at home.

The earliest legislation passed in our state on weed control was enacted by the legislature in 1872 and provided for the cutting of Canadian thistles. However, the law was rather ineffective, as there was no means provided for enforcement. From the days when our pioneers first broke the sod in Minnesota and up to the present time, there has been a continuous introduction of new and serious weeds competing with our grain crops. It is well known that most of the serious weeds were not native to Minnesota, or even to North America, but have been introduced largely through importation of grain and grass seeds. It was not until 1919 that our state passed legislation contemplating concentrated state-wide effort to control noxious weeds. This act provided for a county weed inspector, making it mandatory that each county appoint such inspector. Apparently, public opinion was at that time divided on the problem of weed control work and the need for such local weed inspector and so this act was later revised, making it optional for each county to appoint a weed inspector for their county. Most of the eighty-seven counties in our state do, at this time, maintain a local county weed inspector, whose salary is paid partly by the county and partly by the state, the usual arrangement being on a fifty-fifty basis. It is the opinion of Commissioner Trovatten and Mr. Schrader, that our law should be amended at this time to again make it mandatory that each county maintain a local weed inspector, but that the salary for such inspector be borne almost entirely by the counties.

The 1935 legislature passed what was commonly known as the "Primary Noxious Weed Law," making it possible for the Commissioner to quarantine weed-infested land under certain conditions and that eradication of weeds on such quarantined areas be paid for, when the landowner was unable himself to carry the burden, by the state, county, and township wherein the quarantined plot is located. At the present time, we have 164 of these quarantined projects scattered throughout our state. These projects are under the direct supervision of our Weed and Seed Division and the

type of control work prescribed by the director, with the advice and counsel of our plant pathology and botany personnel at the University. In addition to what actually amounts to research work being conducted in these various quarantined areas, we have had in our state since 1936 or 1937 a joint research project at Lamberton, Minnesota, where the State Department of Agriculture, together with the University and the Bureau of Plant Industry of the U. S. Department of Agriculture, took over an entire farm infested with so-called "bindweed" or "creeping jenny". Much valuable information on effective control and eradication of "bindweed" has been obtained from the research carried on at Lamberton and when this project was initiated in 1936 it was almost impossible to obtain a loan on farm lands located in that area because of the heavy infestation of "bindweed", but because of effective control methods indicated by research carried on here, farm lands in this part of our state are at this time as readily acceptable as loan collaterial as agricultural lands in any other part of Minnesota. The 1935 law earmarks five per cent of our total appropriation for weed control work to the Department of Agriculture for research. Undoubtedly, this small amount spent for research has been of inestimable value to agriculture in our state. We are requesting our legislature at their session this winter to increase the amount of money available for research. It is our considered opinion that research carried on in areas quarantined and set aside by the Commissioner, attacking the problem of control where it actually exists, is far more effective than would be similar work carried on, for instance, in a greenhouse at the University, because we know that control methods that are effective in some particular part of our state are not equally as effective in other parts, as there are factors of soil differences and cropping procedures that have a direct bearing on control methods. It is also desirable that additional research in the field be carried out on some comparatively new isolated infestations in our state on such weeds as Austrian field cress, wild radish, and others. Weeds are mostly parasites and definitely a public concern, inasmuch as they seriously affect our food production efforts. It has been conservatively estimated that crop losses due to weed infestations in our state amounted to more than two hundred and forty million dollars in 1943.

Any effective weed program will, of course, necessarily include adequate seed laws and seed testing laboratory facilities. We believe that we have effective seed laws in our state, preventing the seeding of noxious weed seeds, and recently we have modernized and enlarged our laboratory facilities located at University Farm. During the past year our seed laboratory handled approximately thirty thousand samples submitted by farmers and seed dealers.

To summarize then, we realize that through an effective program of education and an increased effort on research, we will continue to improve and develop new and more effective methods on weed control, to the end that food production may continue at a high level, without which victory would be uncertain, and realizing also, that a prosperous agriculture is the basis of our national prosperity.

MISSOURI

Mr. J. Ross Fleetwood
Extension Specialist in Field Crops
University of Missouri

The reports from Kansas, Iowa and Illinois give a very good cue to the major weed problems in Missouri.

Bindweed is quite a serious weed in northwest Missouri, while Johnson grass is causing trouble in the Mississippi Delta counties in particular. Bindweed isn't as serious a problem as it seems to be in Kansas. Johnson grass causes but little trouble in counties north of the Delta region, so it isn't as serious in the state as it is in the southern states. There is some Canada Thistle in the state, but seed is seldom, if ever, produced, so the spread is confined to that which comes from the roots.

Horse nettle, climbing milkweed, perennial smart weed, the plantains and numerous other weeds are problems, but not acute problems.

Annual weeds and others not usually classified as noxious really cause a great deal more total damage than the noxious weeds in Missouri.

The research program is not as extensive as in some states, but it is extensive enough to keep abreast of the adaptation of current recommendations to Missouri conditions. The program as it is now carried out does not take the time of a research worker, but is done by workers in other projects as time, funds, equipment and opportunity permit.

The educational program in the state is fairly active, although here again, as with research, the weed work is carried as a part of other projects. Thus weed work is carried as an integral part of pasture, seed, cultivation, crop rotation and quality hay programs. The only exception to this is the special work done on bindweed, Johnson grass and Canada thistle. Last year (1943) some 240,000 pounds of sodium chlorate were used. Nearly 500 farmers clean cultivated over 1,500 acres of bindweed. Before the war--shortages of labor and equipment became operative, the average was nearly 1,000 farmers cultivating over 3,000 acres of bindweed.

The seed law is a very good one and it is enforced fairly well. Weed control legislation is, however, very weak and difficult to enforce.

Continued educational work and the development of a more effective weed control legislation would seem desirable in Missouri.

NEBRASKA

Mr. W. L. Klatt
State Weed Supervisor
State Department of Agriculture and Inspection

The Nebraska weed program has expanded rapidly the past several years. Interest and activities in weed control is increasing, even under present day conditions. Actual field work has been somewhat handicapped but the program is growing through district organization and a more rigid enforcement of the preventive features of the law.

Bindweed is the center of interest and the major weed problem in Nebraska. According to the 1943 Agricultural Census, over 27,000 farms report bindweed with a total infestation approximating 400,000 acres. Ninety-six per cent of this infestation is in the eastern half of the state.

Bindweed is costly to Nebraska. Crop losses in past years due to this pest have been millions of dollars. The year 1943 was generally recognized as a good farming year, and also one in which bindweed would not be expected to create excessive losses, yet the estimated loss exceeds $1,960,000. This estimate was made on the basis that this weed reduced corn yields 40 per cent, wheat 25 per cent, oats 35 per cent, barley 40 per cent, and alfalfa and rye each 20 per cent.

The weed program in the state is based on education, weed eradication districts, and prevention of new infestation. Educational activities are fundamental in developing the program. The weed law, particularly the enforcement features, are administered by the department of agriculture and inspection, but the program as set forth in law is integrated with the College of Agriculture. It is the function of the State Weed Advisory Committee, consisting of the Director of Agricultural Extension of the College of Agriculture, the Chairman of the Department of Agronomy of the College of Agriculture, the president of the Nebraska Crop Improvement Association, and the President of the Nebraska Horticultural Society, to maintain the closest cooperation between the Department of Agriculture and Inspection and the College of Agriculture in carrying out the purposes of the weed law. This committee shall also formulate plans for the control and eradication of noxious weeds, and shall assist in the promotion and organization of weed control activities. The coordination of these agricultural agencies is developing a fundamentally strong weed program.

Weeds designated as noxious at the present time are bindweed, hoary cress, leafy spurge, Russian knapweed, Canada thistle, and puncture vine. Other weeds of similar character may be designated by the Director of the Department of Agriculture and Inspection as conditions arise.

Weed control and the organization of weed eradication districts in Nebraska are community problems and depend on the initiative of local landowners. Weed eradication districts are sub-divisions of the state. They may be formed by petition of 51 per cent of the resident landowners or by persons owning 60 per cent of the land in any proposed area. If the county board grants the petition upon the recommendation of the Department of Agriculture and Inspection, a weed board of three or five supervisors is elected by the landowners to administer and to operate the district. The cost of administration and operation is assessed to all landowners, but each landowner having noxious weeds is responsible for the cost of or the work of control and eradication on his land. Noxious weed infestation on raods, railroad rights-of-way, drainage ditches and canals must be controlled or eradicated at the expense of the agencies controlling them.

Weed district supervisors may employ help or purchase machinery for eradication purposes. This practice has not developed to any great extent as the supervisors have been attempting to get the job done on a cooperative basis, each landowner assuming the responsibility of eradication on his land. During normal times this plan operated very successfully. It appears now as if some of the districts will employ trained fieldmen and secure district owned equipment as soon as conditions permit. Successful operation of the districts depends largely on how active the local supervisor boards are.

At the present time, there are 51 districts, ranging in size from 9,600 acres to 590,000 acres. Fifteen of the districts are established on a county-wide basis. The total area under organization represents 6,800,000 acres. The larger organizations appear to be operating more effectively than the smaller ones. It is

interesting to note the progress of the organization. During the first year of the program in 1938, only four small districts were established.

Progress is being made on eradication. In 1943, there were 12,166 farmers working on 48,000 acres of bindweed. Based on the amount of chemical used in 1944, these numbers should be increased considerably. Over two million pounds of chlorate chemicals were used in Nebraska this year. This includes the big carry-over from last year, which was not applied because of the extremely dry soil conditions. The chemical supply this year was very inadequate. In 1943, there were 404 bindweed cultivation machines in the organized districts. One small district reported 43 machines.

The preventive features of the Nebraska law are adding much to the success of the program. These features tend to establish faith and confidence and also bring about eradication in an indirect manner.

It is unlawful to sell or furnish seed, grain, livestock feed, or any other material containing noxious weed seed, unless it is sold for the purpose of such processing as will remove or destroy the viability of the weed seed. Farmers when offering grain for sale must designate the presence of noxious weed seed. To make the prevention program more effective, the Director may also make rules and regulations respecting the removal of any noxious weed infested materials from any premises.

This phase of the program has been quite effective. The weakness in the law at this time is that the shipment of noxious weed-infested material into the state cannot be prevented. It comes under the provisions of the law after it is in the state. The inspectors have been quite fortunate in finding such grain this fall.

In past years, threshing machines have been an important factor in spreading bindweed. After the noxious weed law was enacted, all threshing machines, combines, and other equipment must be cleaned before leaving a field with noxious weed infestation.

The inspection work, in connection with cleaning threshing machines has proven to be especially valuable in developing weed consciousness and the weed program. As weed consciousness has increased, it has been possible to enforce the preventive features a little more rigidly each year.

The Nebraska program may appear to be slow and cumbersome and it requires considerable educational work for district development. This type of program also has advantages in that the preliminary educational work and the circulation of petitions for a weed district by interested landowners develops weed consciousness, community responsibility, and a cooperative attitude that is very necessary for a successful weed program. Another distinct advantage is that an organization is established whose sole interest is weed control, which is administered by individuals primarily interested in weed control. These conditions, along with a state law broad enough to meet the requirements of various individual districts lay the foundation for an effective weed program.

No doubt changes in the law and program will take place as conditions develop to make changes advisable. The law has already been twice amended since its passage in 1937. The Nebraska legislature has been friendly to the weed program and is interested in making it practical and effective.

Mr. Howard: It is now lunch time so I think that we had better close the meeting for this morning and continue with the state reports this afternoon.

SECOND SESSION - November 16.

Mr. Rufus M. Howard introduced Mr. E. H. Everson, Secretary, South Dakota State Department of Agriculture, to preside over the second session.

Mr. Everson: We will continue with the state reports and will hear first from North Dakota.

NORTH DAKOTA
Mr. William J. Leary
Extension Agronomist
North Dakota State College

The weed work in North Dakota is not very extensive. While we have two half-time research workers in the Botany Department, their work includes more than weeds. North Dakota has eight primary noxious weeds: creeping jenny, leafy spurge, Russian knapweed, perennial peppergrass, Canada thistle, sow thistle, quack grass, and dodder. Our weed law places enforcement in the hands of the county commissioners, who in turn can delegate the responsibility to the township road overseer where individuals or cooperators do not destroy the noxious weeds. However, the law while being broad enough is not being enforced. In 1935 there was an intensive program organized for the control of leafy spurge and twelve counties adopted the program. At that time spraying was the control methods used. Main emphasis has been on destroying the small infestations before they become larger. Since that time the dry method of application has been adopted nearly 100 per cent. Thirty of our fifty-three counties have dry chlorate spreaders. The Agricultural Conservation Program, perennial weed control practice is being used. In 1943, 65,461 pounds of sodium chlorate chemical were used; 3,101 acres of creeping jenny and leafy spurge and 76,615 acres of quack grass and Canada thistle were cultivated for tillage control.

The main interest in our state at present is in regard to the control of annual weeds, particularly wild mustard, wild buckwheat, frenchweed, sunflowers, and prickly lettuce. For the state as a whole, the annual weed loss is greater than from perennials.

The weed research work done in North Dakota that has received the most publicity is the use of sheep in the effective control of leafy spurge.

In discussing the perennial weed problem, we can consider it both optimistically and pessimistically. Optimistically, we have many more practical recommendations for their control than we had ten years ago. While on the pessimistic side, there is still a lot of work to be done.

OHIO
Dr. C. J. Willard
Associate in Agronomy
Ohio State University

There are no important provisions in the Ohio Weed Law. It is very old, and was ineffective when it was passed. It requires complaint from neighbors to get enforcement, so is rarely invoked.

We do have a pretty good seed law, perhaps not the best, but at least average, and we are getting excellent enforcement of it.

There is no action program, except that we have extension leaflets to help the individual farmer. As to proposed amendments to the State Weed Law -- that is what I am here for.

We are bothered with Johnson grass on our bottom lands almost as far north as Columbus. A survey seven years ago in three counties showed 5,000 acres nearly or entirely abandoned because of Johnson grass. In 1933, farmers in Ross county chipped in $150 for us to carry on experiments on the eradication of Johnson grass. We found ways to eradicate it, but they involved the complete revision of farming systems, and you cannot do that in a year---or even ten years.

OKLAHOMA
Mr. Clyde A. Bower
Chief Inspector, Entomology and Plant Industry Division
State Department of Agriculture

I represent the State Department of Agriculture. We have in Oklahoma one law pertaining to weeds. It is entitled "Bindweed", and deals with this weed alone.

The County Commissioners are responsible for its enforcement. Any individual can take to them the information that bindweed exists on a particular piece of property and the Commissioner may order the owner to begin eradication methods. If he fails to do so then the Commissioner may hire someone to do it for him and charge the cost to his tax bill.

To my knowledge, this law has never been enforced even once. The weed problem with us is becoming more acute each year. Our greatest trouble is Johnson grass and not bindweed. Many farms have been abandoned on account of it. Some farmers have begun to cut it for hay with no idea of ever getting rid of it. This results in its continued spread.

To me it seems all of us in Oklahoma, who are concerned with the weed problem, must devote more time to educational and research work. Without that a hard and fast control program would be doomed at the out-set. The dissemination of weeds with seeds is adequately cared for under the Oklahoma Seed Law, which provides for an analysis and the proper tagging of seeds which are sold.

SOUTH DAKOTA
Mr. Norris M. Paulson
Director, Division of Plant Industry
State Department of Agriculture

Mr. Everson, as you do doubt know, is the Secretary of Agriculture in South Dakota. He is acting as Chairman this afternoon and that is probably why he called on me for this report. I am with the State Department of Agriculture at Pierre having administration of the Seed and Weed Laws.

Our seed law is modeled pretty much after the Federal Uniform Seed Law but varies in that it offers relative blanket exemption to farmers in farm to farm sales. A minor change in this respect would put it in very nice working condition.

Our weed law is what we are most concerned about at the present time. This law was drawn up a few years ago and does call for eradication of weeds but calls for too much cooperation on the part of the farmers. In our particular set-up our county commissioners are held responsible for any weed program. These commissioners are empowered to set up weed districts and levy funds for the purchase of machinery and material for the eradication of primary noxious weeds under certain conditions. The conditions are the catch. Before the county commissioners can set up a weed eradication program they must have a petition signed by the freeholders of 80 per cent of the land in question. This is where the difficulty comes for it is very hard to get 80 per cent agreement on anything - even weeds. It is not human nature for people to cooperate that well. The funds for purchasing machinery can be levied by the county commissioners to the extent of one-tenth mill upon petition of 50 per cent of the owners of the land taxable. The fact that you have to have 80 per cent of the freeholders in agreement to start the campaign makes this rather ineffective.

In South Dakota we have other agencies in weed control work that are quite active at the present time, they are the Soil Conservation Service and the Extension Service. The SCS has organized several so-called weed rings. In these they furnish the machinery for weed eradication, part of the manpower for operating the machinery and also furnish some technical assistance. Mr. U. J. Norgaard is here representing the Extension Service and he will probably have more to say concerning his own service and the SCS.

SOUTH DAKOTA (Con't.)
Mr. U. J. Norgaard
Extension Agronomist
South Dakota State College

Mr. Norris Paulson of the South Dakota Department of Agriculture has explained to you the essential features of the South Dakota Weed Law enacted at the last session of our legislature.

As stated, our present law enables county commissioners of each county, when petitioned by the freeholders owning eighty per cent of the land to organize control districts. Further, if owners of fifty per cent of the land present a signed petition, the Board of County Commissioners may levy at its discretion, not to exceed one-tenth of one mill on all taxable property in a county for the purchase of machinery and materials for eradication of designated noxious weeds. As explained by Mr. Paulson, the law has not been effective in promoting weed eradication, and a movement is now underway to secure a new weed law designed to be more effective.

I was afraid that some of our sister states would claim creeping jenny supremacy. Therefore, I brought this map which should definitely prove that we are the "Creeping Jenny Capitol" of America. I am showing you a map of a survey that was taken in 1940 in one of our counties, showing the percentage of farmland infested with creeping jenny. The survey was taken by W.P.A. Men employed on the project walked through every field according to a definite schedule and charted all infested areas. You will note that in a large part of the county over 50 per cent of the land is infested. Several adjacent counties are equally infested.

While our weed law has not been effective we have had an extensive voluntary program operating under established agricultural agencies. Extension Service in every county is active in giving service to interested farmers. Last year the county agents reported that they gave assistance to 2,506 farmers.

An experimental cooperative program was started in South Dakota in 1942. The program or project is set up in active soil conservation districts. Under this plan assistance to the district is given by:

1. County Commissioners
2. State Agricultural Extension Service (County Agent and State Extension Specialist)
3. State Agricultural Experiment Station
4. State and County AAA
5. Soil Conservation Service

Responsibilities of each of the above are.

1. The County Commissioners agree to take care of the bindweed along county and state highways through the use of chemicals. The county sprayer is also used on small patches on privately-owned land.

2. The County Agent is responsible for the over-all educational work on bindweed control in the county. State specialists assist the county agent in this educational program.

3. The State Agricultural Experiment Station furnishes all available information on methods of control and assist with evaluation of field results obtained in connection with the action program.

4. County and State AAA encourage the control program as agreed upon through the use of benefit payments. Minimum requirements for compliance are worked out jointly.

5. The Soil Conservation Service provides technical assistance to the district for carrying out a complete soil and water conservation program including bindweed control. They furnish sufficient equipment to the districts for the purpose of carrying on a comprehensive control program within each district in the county. The bindweed control phase of the program is demonstrated through organized "jenny rings." Each ring includes a number of operators living fairly close together. A complete farm plan is developed for each farm which agrees to join the ring, with emphasis on bindweed control through the use of rye fallow, grass seeding, special crop rotations and the use of weed free seed.

The Soil Conservation Districts carry out the tillage part of the weed control program on the acreage to be tilled. This acreage is not less than 10 per cent of the total weed acreage on the farm or not less than 10 acres, whichever is the larger. The cost to the operator is on an acre basis, with the total cost dependent upon the number of cultivations required during the season.

A tractor of the farm-all type and a sub-surface tiller is set up for each ring, the equipment being loaned to the district by the Soil Conservation Service. The District Supervisors hire a tractor operator and furnish the gas, oil, and repairs.

A schedule of operations is worked out based on recommendations of the South Dakota Experiment Station.

Under this general plan 10 Soil Conservation District Creeping Jenny rings are now in operation. 5,079 acres were under treatment this season.

A large number of farmers, not belonging to creeping jenny rings carried on noxious weed control under the state AAA benefit payment program for conservation practices.

In 1943 AAA benefit payments for noxious weed control were made as follows:

For tillage on 16,599 acres -- $165,990.00
For Chemicals - 125,296 lbs. -- 1,252.00

Estimated figures for 1944 are as follows:

For tillage on 14,880 acres -- $148,800.00
For Chemicals - 287,105 lbs. -- 2,871.00

WISCONSIN

Mr. Henry Lunz
Seed and Weed Section
State Department of Agriculture

I presume Wisconsin is the last state to report, so we will have just a few remarks and sign off. I believe that if we could bind up all the remarks that were made here and take a cross section of them, Wisconsin would be about average.

We have a weed law, which was passed in 1860, and which has been amended from time to time, it is a very good weed law. That is about as far as it goes. It is administered by the local officials. The State Department of Agriculture was given some authority a few years ago but no authority as far as administration is concerned. We have been very fortunate in Wisconsin, however, in having more or less a three-way tie up, the state department, the College of Agriculture, and the local officials.

One of the progressive things we have done is that the Wisconsin Department of Agriculture was given authority to call weed commissioner's meetings in the various counties and instruct them relative to weed control, and suggest and recommend ways which they could administer the duties of their office. The weed commissioners are appointed by the township chairman of the various townships. The meetings have become quite popular. For a number of years, we have attempted to meet in each county approximately every other year. These meetings are usually attended by a representative of the Department of Agriculture and a representative of the Extension Service. At this meeting, we attempt to give a short course on weed identification, and suggest how they can best set up a program in their localities and the different methods of weed control that can be adopted. Our law has been only partially successful and our weed control work in Wisconsin is rather spotted. There are certain local townships where something is done but others where not very much is accomplished. We feel that if we are going to have an affective weed control in Wisconsin, it must be under different units than it is now, and I am not prepared to say whether it should be county, state, or what it should be.

Our seed law is largely for the purpose of weed control, and is practically identical with the Federal Seed Act. We feel, and believe we are right, that in the setting up of any law, whether it is a seed law or a weed law, that the least number of seeds or weeds we declare noxious, the more effective those regulations

are going to be. Of course, there is always an argument as to which should be noxious. In the weed law, however, the legislature took that upon itself. I notice that someone said ragweed should be in the noxious weed law. Possibly it should, but I wonder if we should recommend that any weed be on a noxious weed list unless it is a noxious weed agriculturally. We have hemp on our noxious weed list which is a problem, and not an agricultural problem. If we are going to discriminate against any plant, it should be a menace agriculturally and we should not attempt to carry on enforcement from other angles.

WISCONSIN (Con't.)
Mr. George M. Briggs
Extension Professor of Agronomy

We do not have a special weed control specialist in our state. In addition to my duties as a crop specialist on forages and grains - soybeans in particular - there is some time devoted to weed control and, as has been stated by Mr. Lunz of the State Department of Agriculture, some time has been spent with him at county meetings of weed commissioners. The large use of chlorates, which is between 300,000 and 400,000 pounds a year indicates that considerable is being done and whatever is being done is to be credited to the finest cooperation of the county boards, the AAA program, highway departments, and the county extension agents with their agricultural committees.

The extension work is a result of factual information gained at university experimental farms, our substations, and in other areas of the state. Among the problems on weed control, first let me enumerate the work we are doing on the control of orange hawkweed, also called devil's paintbrush, which covers a large percentage of the cut-over area in northern Wisconsin, by the use of nitrogen fertilizer - 150 to 200 pounds per acre - whereby the grass grows so rank as to overcome the aggressive action of the weed.

The use of chlorates is a result of the early experimental work whereby it is being applied to Canada thistles and field bindweed for the greatest part, and in limited amounts to quack grass and leafy spurge. Fall treatment is much the greater proportion of its use, however, highway departments find it possible in midsummer to spray roadsides and to follow up with additional sprays instead of waiting until late fall.

Carbon bisulphide is used in the control of bindweed in a few of the vegetable areas. However, this has only been in a limited way due to trouble getting materials.

The application of Ammate to poison ivy in addition to the use of chlorates at midsummer time has been the result of experimental work at University Farm. This has been adopted to the extent that some highway departments use Ammate for many areas along their roadsides. In one county it is claimed that hospitalization and insurance cost the highway department $1000 in one year and from the highway department's own figures it would perhaps cost no more to rid the county of this pest.

The use of Sinox is also a furtherance of the research done on farms to the extent that we have outfits owned by individuals and counties in 13 of the eastern Wisconsin counties. It is only because of the shortage of labor that more extended use isn't made of this practice.

Cultural programs which consist mostly in summer fallowing is a result of practical field demonstrations with satisfying results. Through the AAA many counties are using the quack grass control fallow method. We have a few places in the state where summer fallowing bindweed in combination with early canning crops is being carried on.

There is no attempt made to enumerate the number of demonstrations, total amount of materials, and total number of farms involved. However, we do know there are many thousands of so-called weed fallovators in the state. Perhaps 1000 of them in each of many counties where with narrow tooth shovels quack grass control is being accomplished as never before.

It appears to me at this conference that very little has been said as to methods of getting back to the farmer on influencing him to action. Should I be permitted in a year or two I think perhaps I would welcome the chance to give information on results of how to get cleaner grains because of a program we are inaugurating in a limited way this fall. I believe we have been too tolerant in permitting noxious weed seeds in our seed grains. Surely this deserves, from my views, much more follow-up than we are giving it here - and the fanning mill is the first offender.

My thoughts go back to 1884 when a farmer came to a county board in northern Wisconsin and complained about a certain weed that he had on his farm. No one seemed to know what it was. However, this farmer stated that it was getting so bad that he should have help from the county board in trying to get rid of it. His request was laughed at and the only reason I bring this up is because here was the common Canada thistle only 60 years ago starting in the state and the public didn't know its name, just its trouble, but public support for controlling these little areas was not forthcoming. It seems that there is opportunity at this time to get the public concerned with the other man's business before it is our business.

Our successes have been brought about over the objections and the differences of different departments, agencies, and individuals. It seems that I have always lived with inhibitions and in weed control work there seems to be plenty. Right now with war on and demands on labor and food so prominent that we cannot proceed with any large weed control effort, but we look forward to greater efforts when times are more normal. Some of the problems between us and other departments and agencies that have had to be worked out and smoothed over to the end that all of us were working in harmony are the following:

1. AAA gives splendid support on the use of chemical and fallowing for earning allowances. However, the first year when provision was allowed for fallowing, the control program was not very definite and I feel we accomplished something when we had them appreciate that we should designate that fallowing should begin at certain intervals with a special machine, and this has been accomplished. It is regrettable however, that so much feed wheat has come into the market which has helped in a small way to reinfest our farms with mustard and I presume other bad weeds. Our state department through Mr. Lunz I believe has done everything possible to head this off but I believe the practice continues.

2. The Soil Conservation Service really leaves the impression that quack grass is not such a noxious weed, in fact may not be so bad on some farms where erosion is a problem. As long as we continue leaving quack grass on the noxious weed list as it is in our state and it is not controlled - in fact favored by some agencies - it serves as a joker in preventing any of the provisions from being carefully

followed out. I think this is something that people responsible for weed laws should be thinking of because any time a weed included in a noxious weed list is found every place, and little is done about it, it would seem that either we ought to change our list or change our ways.

This same organization has done a wonderful piece of work in working hillsides by strip cropping and contour working of the land but on these narrow strips weed control by machinery is next to impossible where opposite cultivations would be desirable. We are attempting to further what we call the zig-zag cultivation method whereby good fallowing can be done at less expense.

3. In our Game Management Department, while there is no special issue, nevertheless they claim weeds should be left in fence rows for game propagation purposes, while we feel sometimes this is the source of many weed seeds and serves as a menace in the whole community.

4. Our highway departments of state and in some instances in counties, provide maintenance for treating weeds only under pressure. It would appear as though a greater cooperation could be brought about between town, county, and state. Furthermore, provisions are made for farmers to control weeds along their own fence line and on roads that are not patrolled, to the center of the road. This makes bad feelings for those who do not live on patrolled roads and there seems to be a loop hole whereby many weeds are permitted to go to seed and good control programs are not brought about.

5. Our Agricultural Engineering Department feels that efficient corn crops can be drilled in while we know definitely that checked corn really does afford a better weed control. It is the contention by the department that serious weeds should be controlled sufficiently before planting. However, the check rowing does offer greater opportunities.

6. Threshermen in many instances could have screens on their machines which would do a fine job in leaving all the weed seeds under the machine instead of in the grain or in the straw, but farmers will not cooperate threshermen claim, with very few exceptions. Therefore there exists a new problem with the farmer himself.

7. The tenants say that the landlord doesn't care about weeds so they let the weeds go to seed. How best to overcome this problem nobody knows, but it is a problem nevertheless.

Yes, I suppose the last inhibition I get is from my own home where some of the bindweed work has been carried on in my own garden and where my housekeeper, Mrs. Briggs, doesn't seem to feel that chlorates help her tomato patch. So overcoming these inhibitions and living along with people to the extent that we can have fewer weeds in this country is no small job. I feel it is worth it, but I do feel we have to get back to appreciating that the other man's troubles will probably be ours unless we arouse public interest in the whole weed control program.

COLORADO

Mr. R. H. Tucker
Extension Agronomist
Colorado State College

We from Colorado are very pleased to have been asked to come to this conference. I doubt whether we can make very much of a contribution to your program in the way of any suggestions, proposing laws, or programs on weed control. We hope however, to get suggestions to take back to Colorado that will be of benefit to us.

We have not made any weed surveys in Colorado to determine how many farms are infested or how much the infestation is. The only kind of surveys we have made are seed surveys to find out what kind of seed and the weed seed content of seed that farmers are planting. In connection with these seed surveys some of our county extension agents have gone out in the spring during the planting season and have taken samples of seed from the drills as farmers actually were planting. These samples then were taken and tested by the State Seed Laboratory for purity and noxious weed content. Through these surveys we have discovered a rather alarming situation, showing in some cases at least, that 80 per cent of the small grains that farmers were actually planting contained one or more noxious weeds. Therefore, we are strongly stressing a clean seed program to accompany or precede any control program.

Our program in Colorado is perhaps a little different as most of our difficulty and most of our noxious weeds are on irrigated lands. Nebraska, I expect, is about the only state represented here that has much irrigation.

Four years ago a state-wide meeting was held in Colorado to discuss weeds and weed laws. At that time we were trying to see if anything could be done or any law put into effect that would make our weed work a little more effective. We have had in Colorado, for a long time, a law whereby 51 per cent of the resident landowners could petition and form a compulsory weed district. Many districts were formed but none of these compulsory districts have been very successful. We still have this law but we have a new law designed to make weed control a little more attractive and easier for farmers through furnishing better equipment, cheaper materials, etc. This new law is an enabling act and it says "may" rather than "shall". It enables county commissioners to make a levy for weed control work, permits them to purchase materials and equipment, hire supervisors, and make contracts for control of noxious weeds with landowners or operators. On good agricultural land the policy up to date has been to require the land to stand the total cost of eradication but on waste land where the cost may be more than the value of the land some public or county support must be given.

There has been a lot of interest and several counties have developed programs during the past couple of years under this new law. None of the programs are very complete but we feel that it will be much easier to expand these programs after the war when equipment and labor are more readily available, than it will to initiate them at this time. In other words we feel through starting these programs now that we will be able to expand them materially when we can get more labor and equipment.

WYOMING

Mr. George Harston
State Entomologist
State Department of Agriculture

The following report was intended for presentation at Omaha, but Mr. Harston could not be present at the Conference. Mr. Harston submitted the report for inclusion in the proceedings.

Important Provisions of State Weed Law

Pest Control Districts. The Wyoming law provides for the creation of pest control districts which shall comprise not less than 24 square miles of contiguous land.

To create a pest control district the majority of resident landowners, representing seventy-five per centum of the resident-owned land within the contiguous territory, must sign and file a petition with the County Clerk of the proper county. An opportunity is given for objectors to present their views in a hearing before the County Commissioners. If the objections be disallowed the County Commissioners formally create the said districts.

Financing of Program. Provision is made whereby the counties, having legal pest control districts, may levy a tax, not to exceed one mill on each dollar, upon all the property in the county for the purpose of pest control within the district or districts.

Funds, appropriated for weed control by the state legislature, may be allocated to counties having pest control districts; provided, the respective county furnishes an equal amount and the landowners, upon who's property work is performed, also furnishes an equal amount. With this arrangement the landowner, the county, and the state each pay one-third the cost of weed control and eradication.

When weed eradication has been completed on a unit of land by the cooperative program; and after a test period of one year has been allowed to determine the thoroughness of eradication, the landowner is then completely responsible for future control and eradication work.

Administration of the Program

In counties wherein pest control districts are formed, the County Commissioners appoint three landowners to act as a Pest Control Commission. The Commission appoints and hires a Pest Inspector and deputy inspectors as the circumstances require.

The State Entomologist is the administrative official representing the state.

Quarantines. The Commissioner of Agriculture holds the authority to declare quarantines considered advisable for the protection of the state, or localities within the state, from the spread or introduction of insect or closely related animal pests, poisonous or injurious plants or plant diseases -- including noxious weeds.

Seed Law. Each package or lot of seeds in packages of more than five pounds must be labeled giving information as to kind, name of vendor, purity, germination and origin.

Twenty-one weeds are listed as being prohibited in any seeds sold or offered for sale in Wyoming.

Each vendor of seeds must be registered with the State Department of Agriculture.

The Commissioner of Agriculture is vested with the authority to enforce the state seed law.

Provision is made for a state seed laboratory and a state seed analyst. Resident firms, persons or corporations may receive two tests of seeds free of charge each calendar year. A slight charge is made thereafter.

Progress of the Program

The weed control and eradication program has been limited because of inadequate funds. Although the perennial weed infestation has spread considerably since the inception of the program, the measures employed have been effective in retarding the spread, and in restoring many acres of infested land to full production.

The major objection to the past program is that the funds made available by the state and county organizations have not been sufficient to give aid to more than a small minority of landowners who need and desire assistance.

Lack of funds and enforcement personnel have also been seriously felt in the enforcement of the seed law.

Proposed Amendments to the State Weed Law

Local groups throughout the State of Wyoming are advocating such changes in the weed laws, with the intent of making the weed and seed control program more effective. Some of the proposed changes are as follows:

1. It is proposed, by some, that the counties having a serious weed problem, be permitted to legally assess more than one mill on the dollar for weed eradication purposes; and that the state appropriation be allocated to counties in proportion to their requests for state aid. This power to assess more than a one mill levy is considered to be needed in some counties to furnish funds sufficient to more adequately take care of the needed program.

   Some groups are advocating that a greater proportion of the cost of weed control be charged to the landowner; thus, making it possible for the available state and county aid to be distributed among a larger proportion of people.

2. It is suggested that all landowners be required to prevent noxious weeds on their property from producing mature seeds or pay 100 per cent of the cost for noxious weed seed control, if it becomes necessary for the county to do the work for the protection of the neighborhood.

3. A change would be desirable providing for the payment of salaries and expenses for county pest inspectors from state and county funds. Under the present arrangement the landowner, on whose property weed eradication work is performed, pays for one-third of such expenses.

General Comments

Weed infested land belonging to the Federal government constitutes a serious menace to adjacent farm land in the state. Landowners are very eager to have the Federal government control these weeds. Private landowners also are greatly concerned about the weed infestations on state land, state highways, and county roads. The limited funds have not permitted proper control of weeds on this property.

There seems to be a very serious need for greater coordination of effort in weed control work by different organizations and agencies. Many citizens feel that better results could be obtained if funds from the Federal government and from the State were allocated to the local, county organizations, and these county organizations were permitted to pool the funds and use them as seemed most advisable under the particular local conditions.

Under the present system the only Federal funds available for weed control is through A.A.A. payments. It is thought, by some, that these funds should be made available to one definite organization which is equipped to do the work.

Mr. Everson: We have finished the state reports. We will now hear from Mr. Walter Ball of the State Department of Agriculture in California on their state program and also about the "Western Weed Control Conference".

THE WESTERN WEED CONTROL CONFERENCE
Mr. Walter Ball
Chief, Bureau of Rodent and Weed Control and Seed Inspection
California State Department of Agriculture

The weed control work in California is set up somewhat differently than the organized district plans, as mentioned in several of the reports here today. We have a County Department of Agriculture in 49 of the 56 counties in the state. These 49 counties are those in which agriculture is important enough to justify these offices. The County Department of Agriculture is administered by a County Agricultural Commissioner, and his organization is made up of Deputy Commissioners and Inspectors. These men carry out the regulatory work in the counties, working in cooperation with the State Department of Agriculture in the enforcement of the regulations of the Agricultural Code. The duty of the County Agricultural Commissioner is to prevent the introduction of, and to eradicate or control, pests entering or already established in the county. Therefore, the weed control work is under their jurisdiction. Much of the educational and service work is carried on in these county departments with their regulatory functions.

There has been a great deal said by those states reporting relative to laws and the reasons why these laws are necessary. I believe that all of us know of many laws in the statutes that are put there for a purpose, but in too many instances are never enforced. I believe, in the case of weed control and our seed inspection work, that the possibility of enforcement should be given a great deal of thought

at the time that such legislation is being proposed, as I believe that laws are only as good as the enforcement made possible to carry them out. It has been the experience of those of us in the enforcement work in California that the enforcement of the laws brings out the weak points, which by amendments or additions eventually sets up provisions that are enforceable.

Cooperation with the many agencies which are directly or indirectly concerned with weed control problems in California has brought about a very satisfactory condition. Our Department cooperates very closely with the Experiment Station, with agricultural organizations and schools; and, more recently, we have been working with the State Highway Department and the railroad systems of the state. We feel that a great deal of time can be spent working with the highway and railroad officials, helping to give them all the available information we have relative to weed control as it has to do with their conditions. I believe that we overlooked the fact that the maintenance engineers are not trained in the field of weed control and that, when they are requested to control or eradicate pests on rights of way, they conscientiously attempt to carry out control measures without fully understanding methods and procedures.

Some of the special programs which we are carrying out might be worthy of mention, inasmuch as they have not been touched upon in the reports so far. Our selective spray program has been one of the most satisfactory as well as practical programs to date. There are reasons, of course, which have put this program where it is. First of all, due to the labor condition it was impossible for the vegetable growers to get labor to handle the weeding of such vegetable crops as carrots and onions. Through the cooperation of the county offices, the Experiment Station, and our Department, the selective spray program was worked out with the use of fuel oil for the control of annual weeds and grasses in carrots; and sinox, for the control of weeds in onions and garlic. The sinox program, however, was not successful in those areas where certain of our grasses predominated. The programs were readily accepted by commercial spray operators, and the growers of these crops were offered contracts of around 8 dollars per acre for this weed control work--the 8 dollars being very attractive due to the fact that hand weeding normally costs from 70 to 85 dollars and, in some cases, 100 dollars per acre. Several hundred acres of these vegetable crops were saved, the food being placed into marketing channels when this type of food was needed badly. In case any of you are interested in the selective spray as carried out in California, I would suggest that you request circulars prepared by Mr. Raynor of the Botany Division of the University of California at Davis.

I was very much interested in the reports of several of the states that mentioned weed and seed discrimination through seed and feed. California recently experienced the movement of a very large quantity of Canadian wheat into California for feeding purposes. It was found that this wheat was infested with Canada thistle and quack grass--two weeds, fortunately, that are very limited--and we were very anxious to prohibit their introduction. This wheat was being introduced through CCC and handled locally by our AAA State and County Committees. The fact that practically all of this wheat came in by boat, which in many cases carried as much as 200 cars, made the quarantine problem a serious one, inasmuch as it was necessary to hold many cars under quarantine for cleaning and processing. The results of this brought about hearings in which it was attempted by CCC to get special provisions whereby the state would lower the tolerances on the movement of weed infested wheat. This we could not do and did not do; and, furthermore, it was difficult for us to understand why a federal agency should take such action rather than cooperate with

a state agency which has for many years carried out an extensive weed control program costing California agriculture large sums of money. We recognized that a movement of wheat for feed was a very necessary measure as far as our livestock, poultry, and dairy industry was concerned, but we could not understand why it was necessary to introduce and possibly establish weed pests that would take a good many years and a lot of hard work on the part of the boys now in the service to eradicate upon their return, especially when we found that the cleaning equipment available in California satisfactorily cleaned these weeds from the wheat. We saw no reason why steps should not have been taken to have had this feed cleaned to comply with the regulations of California, thus eliminating the trouble which was brought about by the action taken. We have a similar problem in interstate movement of feed grain from Texas and other states.

I should like to take another minute or two to tell you of the enforcement of the California Seed Act, which is rather a new act, as far as the seed industry in California is concerned. Our Seed Act is patterned very closely with the Federal Seed Act and the Uniform State Seed Laws. We have found, of course, that it was necessary to make some minor changes in order that the law more nearly conform with the conditions under which it has to be enforced. The seed industry of California is one of our most important agricultural industries and, inasmuch as the seed grown in California is shipped throughout the United States, we attempted to comply as nearly as possible to the Federal Seed Act, hoping that, before too many years, other states will attempt to bring about more uniform regulations.

I believe that gives you a few of the problems we have in California. We have, however, many more and have some rather interesting and extensive weed control projects in operation.

Inasmuch as I am to appear next on the program to discuss the Western Weed Control Conference, I will speak now as Secretary of that organization. Since I understand that one of the objectives of your meeting here is to organize a North Central Weed Control Conference, I shall give you a little history of our Western Weed Control Conference.

The need of this organization was discussed by Professor G. R. Hyslop of Oregon and Harry Spence of Idaho and myself. The first meeting was held in Denver in 1937, at which time it was decided that such an organization could be helpful insofar as close cooperation between the states and coordination of effort would, no doubt, be important in any action taken toward federal weed control programs or policies. In organizing this group, we felt that each state should be represented and this representative would be the official representative at our annual meetings. The representation was made up of members of the Extension Service, Experiment Stations, and State Departments of Agriculture. Our meeting in Salt Lake City, this last spring, was our sixth annual meeting; and inasmuch as I have been secretary since our first meeting and have attended all of the meetings, I can state that the interest in weed control sectionally has increased a great deal.

I am very glad to know that you contemplate another such organization in the North Central States, which will give us a total of some 24 states thinking along the same lines. I feel quite sure that close cooperation between these two organizations will bring about greater unity and this unity can do nothing other than bring about better weed control practices. I do not believe that it is going to be many years before our weed control will be given national recognition and that,

when there is national weed control organized, appropriations made and personnel selected, those of us in these two conferences should have some voice in the planning and organization of such a program.

There are, as all of you know, a number of federal agencies, at the present time, which are directly or indirectly interested, or should be interested, in weed control. Those of us in the various states have found it very difficult to get cooperation through some of these agencies. I am thinking particularly of the Indian Service, U. S. Forestry and Grazing that are particularly active in the western part of the United States; and, so far as our Western Weed Control Conference is concerned, affect all of us. The Bureau of Reclamation, however, has taken a very active part in weed control and we have had excellent cooperation.

With postwar programing, which seems to be paramount in the minds of most of us at the present time, I believe that there will be new agencies introduced into the national picture in our field of weed control. As far as we are concerned in the West, we feel that AAA will continue and possibly expand. It is with some of these facts in mind that I believe your proposed organization, cooperating with the Western Weed Control Conference, can play a very important part by exchanging ideas and agreeing upon a few of the more important factors and backing these points.

I appreciate very much having an invitation to attend your meeting and to have the pleasure of personally meeting and talking with many of you with whom I have corresponded and whose publications I have read. I am extending an invitation to all of you to attend our Western Weed Control Conference next spring.

Mr. Everson: Thank you Mr. Ball. We will now hear from Dr. Keim, who is Chairman of the Department of Agronomy, University of Nebraska. He will discuss "What Constitutes a Good State Weed Law and Program."

WHAT CONSTITUTES A GOOD STATE WEED LAW AND PROGRAM

Dr. F. D. Keim
Chairman, Department of Agronomy
University of Nebraska

A good noxious weed law is the backbone of a good weed eradication and control program. Just what are the advantages of such a law?

1. It furnishes the machinery and organization for action.
2. It definitely delegates responsibility and a good law provides for the man power to get the job done.
3. A good weed law must carry an appropriation large enough so that the very best type of personnel can be provided for carrying out the plans.
4. To be the most effective it must be kept out of politics. It is no place to pay political debts because trained men for this particular job should be made available and employed.

The type of men necessary to carry out a good program.

If a law is to be effective it must be backed by enforcement. This requires men who are fearless and not afraid to act if necessary. It also requires men

reasonably well trained in weed and seed identification. A good program requires that a weed survey be made and this cannot be done by incompetent help. It requires tact and diplomacy. It is always much better to get folks to want to do the job rather than to force them to do it.

Should Include All Noxious Weeds

A good law should be broad enough to include all the noxious weeds that may prove to be a menace. Ordinarily the weeds to be feared most are the perennials that spread by both seeds and under ground rootstocks. A law should not be encumbered with such annuals as fox tail, pigweed, etc. In general the law must be inclusive but not burdened with unnecessary details.

All Agencies Should be Called Upon

A good law should be broad enough to include all agencies and organizations that can be of help in carrying out educational, survey, and enforcement programs. The Agricultural Extension Agent with the help of the Extension Agronomist or Botanist, The Crop Improvement Association, the State Horticultural Society, the Soil Conservation Service District Supervisors, the County Commissioners, and other county officers should all work together with the organization set up by the law. The aims of all of these organizations have much the same objective and that is to render service to the farm and the public that makes up its citizens. One helps the other and all together much is accomplished. I hope you will pardon one reference to our Nebraska law. It illustrates what I have just mentioned. Our law calls for a Noxious Weed Advisory Committee to be made up of the following: the Director of Agricultural Extension (Chairman), the President of the Nebraska Crop Improvement Association, the President of the State Horticulture Society, and the Chairman of the Department of Agronomy of the Agricultural College. The committee meets at regular intervals and establishes with the assistance of the State Weed Supervisors the education, law, enforcement, research, and organization necessary to carry out our program. In other words together we make real progress or divided we fail.

District or State Organization

A good law must provide some sort of organization that will allocate responsibility directly to the farmers themselves without any political control. The larger number of farmers interested in the problem through proper organization the more accomplished. In Nebraska at present we have approximately 50 districts established and this includes about 250 weed supervisors. How different is this from the old days when no one mentioned weeds but the Agronomy teacher or the old Farmers Institute speaker and they sort of mentioned them in passing as something bad but not much could be done. Now we know that perennial weeds can be eradicated and at much less cost than any one imagined.

Prevention Rather than Eradication

A good law should provide for every possible aid in the prevention of noxious weeds. Some research has been done on this problem and much still needs to be done. Just how do weed seeds spread? How much of this is done through the threshing machine, the movement of bindweed seed, and other noxious weed seed in grain and all other seed used by farmers in planting their crop? How much in all forms of feed, grains, hay, straw, manure, nursery stock, and the road drags and graders.

Everyone knows that the above can be and many times are vicious carriers. Therefore education, inspection, and enforcement along these lines are very necessary.

The Law and Weed Research

A good law that is not backed by a thorough weed research program in the Experiment Station is almost sure to fail. I shall not enlarge on this subject because this conference has many papers stressing the research now being done on its program. Without the research on prevention, the eradication by use of chemicals, the starvation of the root system by cultivation methods, and various competition studies, any law enforcement program would run directly up against a stone wall. If this research is not being done by other agencies the weed law of any state should demand that it be done and furnish appropriations to the Experiment Station for that purpose.

Any Law Requires Strong Leadership

I stressed this earlier but I think it is extremely important. Any state-wide organization or district system nearly always has a tendency to stand still unless energetic leadership is provided. This condition is usually not the fault of the law but is brought about by those in charge of carrying out the purposes of the law. The law is a means to an end. The result largely depends on the personnel in charge.

Other Considerations

Whether the Kansas unified state-wide organization or the district type such as Nebraska has adopted makes little difference. Both of these cases have their advantages and disadvantages. Most of these have been discussed by the men in charge. The main thing is to have a law that definitely allocates the responsibility so that a thorough weed eradication and control program is put into action.

Should the state or Federal government reimburse the individual farmer for all or part of the costs of eradication of weeds on his farm? This is a much debatable question. Without question the wealth of the state and nation is concerned. It is not always the farmers fault that his land is badly infested with perennial weeds and probably in many cases, county, state, or federal aid is justifiable. For the most part farmers are proud of their small domains and are willing to accept much of the responsibility.

There is still much to be accomplished in establishing a more definite program on non-agricultural lands. Much progress has been made and owners of non-agricultural lands have done a good job in cooperating with the various state laws.

A good weed eradication program should furnish numerous opportunities for returned veterans. The weed problem is so important and the losses so great that most agricultural counties in the corn belt could well afford to hire a county weed supervisor. This man should cooperate closely with the state program and possibly should be partly paid by the state.

The laws enacted by the various states, the interest shown in this conference, and the general progress being made is very gratifying. Let us keep clearly in mind that the lands of the Nation can be freed of noxious weeds. It takes good organization and a lot of leadership and hard work, but it can be done.

Mr. Everson: Six years ago, the legislature in my state abolished the state seed administration, and gave its duties to the Department of Agriculture, but no money. I said, "Aren't you going to appropriate some money to carry on the work"? "How do you expect the law to be administered"? The answer was, "We don't expect it to be administered". After all, if they don't want to do it, there is no use trying. We must get them to want to do it.

We will now hear from Mr. R. C. Kinch, State Seed Analyst from Nebraska on the "Prevention of Interstate Movement of Noxious Weed Infested Material."

PREVENTION OF INTERSTATE MOVEMENT OF NOXIOUS WEED INFESTED MATERIAL

Mr. R. C. Kinch
State Seed Analyst
Nebraska State Department of Agriculture and Inspection

No study of the noxious weed program would be complete without considerable thought and discussion on means of dissemination by seeds or plant parts. Each new infestation of any kind of a weed began with the single plants. At one time the infestation of field bindweed, Convolvulus arvensis, in the United States was confined to a few scattered plants. Since this plant has been living with man for hundreds, even thousands of years, or perhaps ever since man first began scratching the soil and cultivating crops, it has been adapting and perfecting its means of reproduction and dissemination to coincide with those of many of man's principal crops. How well this field bindweed plant has achieved its goal may be seen by its spread with man's help in about 75 years from a few plants to approximately 400,000 acres in the State of Nebraska alone. Other states have had similar experiences and today this menace has extended over millions of acres of the best cultivated land in the United States. The same situation exists with respect to other noxious weeds which have greatly extended their hold and are menacing crops everywhere.

When any weed is confined to a few plants or small areas, effective eradication measures can be applied and the weed eliminated. But where the infestation is widespread and all the weeds cannot be simultaneously eliminated, control measures will have to be applied to prevent further spreading by plant parts and seeds. The greater the extent of infestation, the greater is the need of effective control measures, until that time when all of the weed can be eliminated.

Many of our weeds are of a very persistant and troublesome nature and are a serious detriment to crop production. This type of weed must be eradicated and completely eliminated, the same as many of our plant and animal diseases. The field bindweed has been recognized as such a weed in Nebraska and during the past several years, a concerted drive to eliminate this weed from the state has been developing and gaining momentum. In conjunction with the eradication effort, more strict control is being applied to the movement of field bindweed infested material.

Seeding Habits of Weeds

A thorough understanding of the habits of a weed is necessary before effective control measures can intelligently be applied. Much experimental work has been and is being done on methods of eradication. A great fund of knowledge is being developed on the growing habits and characteristics of the most troublesome weeds with the objective of discovering each weed's weakest points. Thus indicating

methods of attacking the weeds and destroying them with the least time and expense. Seed production and dissemination habits of these weeds have not been studied as thoroughly as the plant habits and our knowledge is very incomplete. Nature has caused seeds of each weed to vary in shape, size, color, weight, and seed coat texture along with such internal factors as dormancy, after ripening, and impermability of seed coats. To illustrate the problem of extreme variation in seeds, a seedsman in Nebraska sent one bushel of wheat heavily infested with seed of field bindweed to the research engineer of one of this country's leading manufacturers of gravity cleaners and separators. After four months of experimentation, the research engineer wrote back that this weed seed varied greatly in many respects and he was unable to find or devise any method or machine which would remove the field bindweed 100 per cent.

Most weeds mature seeds through the summer, dropping some seeds to the ground before the crops are harvested, allowing some seeds of various stages of maturity to be harvested with the crop, and maturing some seeds after the crop has been harvested. When harvested with a crop, weed seeds may be found in any one of three stages of threshing--namely (1) intact fruit, pods, receptacle, or spikelet, (2) naked seed as it normally drops free of its husks or glumes, and (3) with outer seed coat removed. The latter is definitely a threshing injury but many seeds will germinate with more or less injury.

Principles Involved in Weed Seed Dissemination

Practically all new weed infestations start from seed introduced with planted crop seeds. The heavy centers of field bindweed infestation in Kansas, Nebraska and South Dakota have all been traced to plantings of small grain. Once established in a community, the spread is rapid by the interchange of feed and seed from farmer to farmer. This spread has been roughly estimated by T. F. Yost and others of Kansas to be a doubling of the infested area every five years. F. D. Keim of Nebraska stated that for 25 years, he has been talking about the field bindweed plant and its dangers to farmers. But farmer practices continued as in the past and the infestation continued to increase until stopped only a few years ago by the inauguration of an active educational campaign on control and eradication, by which the farmers were made aware of the weed, its danger, and the reasons in dollar and cents for eradicating or avoiding the weed.

I think the last point bears repeating. The infestation continued to increase until the farmers became aware of the reasons in dollars and cents in their pockets for eradicating or avoiding the weed.

This does not mean that every farmer eradicates his weeds or avoids bringing infested material on his place, but he at least, has heard about the weed and knows that its presence on his farm will entail a financial loss to him.

Nebraska Weed Law

A few of the features of the Nebraska Weed Law may be of interest at this time. This law designates field bindweed, Canada thistle, leafy spurge, hoary cress, Russian knapweed and puncture vine as noxious and provides for their eradication and control. It provides for the formation of corporate eradication districts administered by the local people, who are able to enforce complete eradication and control within the district. Two sections of the law, Number 17 and 18, deal with the movement of machines, vehicles, and materials containing noxious weed seeds and

provide that: (1) harvesting machinery and other equipment operating in infested areas must be cleaned before moving to prevent seed from being carried to the next place; (2) infested material transported along a highway or railroad must be transported in such containers as will prevent leaking or scattering; (3) all common carriers must clean their vehicles and destroy the refuse; (4) no seed, grain, screenings, or other material infested with noxious weed seeds or plant parts may be sold except for such processing that will destroy the viability of the weed seeds; (5) no material can be sold as seed or livestock feed until it has been processed to remove or destroy the weed seeds.

Interstate Movement

As soon as a little headway had been made in the enforcement of the provisions restricting and controlling the movement of noxious weed infested material, cases began to appear that were not governed by state law. Out-of-state firms and individuals were found to be shipping seed, grain, and other materials into the state which were infested. The receiver or farmer usually was not well enough qualified to make an immediate examination to detect the presence of seeds of plant parts of noxious weeds and turn the shipment down. After the materials had been admitted and paid for the case was closed as far as any legal recourse was concerned.

Farmers living across state lines found that they could haul and sell across the line with impunity as long as they watched their step and did not get caught across the line.

Truckers hauled grain and other materials across the state line and peddled their cargo among the farmers. Many farmers being somewhat suspicious asked if the truck's load of grain contained bindweed. Of course, the answer was "No". Many times the farmer bought only to later find that bindweed was present.

Brokers and commission merchants bought and sold across state lines without having seen the material or ascertained whether it was contaminated or not.

These are a few of the practices that are contributing to the spread of noxious weed infested material in interstate commerce which are entirely uncontrolled at the present time.

A new practice has just been found in Nebraska the past few weeks. It is as yet too early for us to definitely state whether we can control it or not. It seems that an out-of-state commission firm sends grain into the state to be sold but the ownership is retained and all financial transactions are made in the name of the out-of-state concern. The agent handling the transaction is not financially responsible himself and assumes none of the financial obligations of the transaction. It is my belief that a good seizure clause in our law, as most State Seed Laws have, would allow us to take care of such cases as this in a hurry. With a seizure clause in our law, the Department of Agriculture could seize the material and stop its sale. The owner then would have to post a bond to claim the material or else forfeit his claim to it.

State Seed and Weed Laws

Every state in the United States has a seed law. All but one of these states has an active seed testing and seed law enforcement program. A seed law provides for the testing and labeling of seed being sold for planting purposes, thereby,

enabling the farmer to ascertain the quality of the seed by reading the analysis tag. Quality of seed refers to its variety or inherent germ plasm, purity, germination, origin, etc. Freedom from noxious weed seeds is only one of the several items that make up seed quality. The objectives of a seed law are quite different from those of a weed law and these two laws should be separate but the enforcement of the two laws should be closely correlated to avoid duplication and inefficiency or perhaps controversy.

Seed laws include only seed intended for sowing purposes and do not cover grain, feed, or other materials which may be infested with noxious weed seeds. Also most seed laws allow a tolerance for the occurance of noxious weed seeds which will permit a small number to be present without even being indicated on the seed tag. This small number of noxious weed seeds is usually sufficient to heavily infest a field. The new Federal Seed Act which became effective in 1939, covers only seed in interstate commerce intended for sowing purposes, so it cannot be expected to control the interstate movement of infested grain. The Federal Seed Act also provides that the noxious weeds covered in the act shall be those of the state into which the seed is being shipped, subject to prescribed tolerances. However, to Nebraska which prohibits the sale of seed or livestock feed containing any seed of the primary noxious weeds, the provision allowing tolerances opens a loophole for the admittance of noxious weed infested seed--a situation which this state cannot do anything about. Let me illustrate with an example of seed oats. The Federal Seed Act prescribes that a minimum sample of 500 grams, a little over one pound, of the cereals shall be examined for the presence of noxious weed seeds. If the state into which the seed is being shipped has a zero or no tolerance such as Nebraska has, the interstate tolerance under the Federal Seed Act shall be two seeds in the 500 grams. Five hundred grams of oats containing two field bindweed seeds when translated to bushels would be 58 seeds to the bushel. This state has prosecuted farmers, truckers, and elevator men for selling oats containing less than half that number of field bindweed seeds to a bushel. With a normal oats seeding rate of two and one-half bushels to the acre, a farmer would be planting field bindweed seeds at the rate of 145 to the acre--enough to start a heavy infestation.

Grain Grading

All grain sold or handled through the terminal markets is inspected and graded according to commercial grain grading standards. The occurance of noxious weed seeds, as such, is not a factor in grain quality. If the grain is to be shipped to country points to be used for seed or feed, the kinds of noxious weed seeds present, immediately become important factors. Only a small proportion of the total grains handled by the terminals is sent back to country points for feed or seed so the listing of noxious weed seeds on the grain inspection report would not be a very important factor with most cars of grain. A grain inspection report listing noxious weed seeds, should not be relied upon entirely as there may be errors in sampling and inspection, but such a report would definitely rule out heavily infested lots of grain for sale as feed or seed.

Uniformity of State Laws

Every state represented in this conference has one or more laws on mowing, destroying, or eradicating weeds. These states also have laws relating to the control of the movement of noxious weed seed infested materials, but no two are alike. Some states have quarantines on the importation of noxious weed infested materials and some have quarantines prohibiting the exportation of such materials from

infested areas. The eradication of noxious weeds within a state is each states own problem but the control of possible sources of new infestations must be the job of the several states.

It seems that states with laws or regulations prohibiting the sale of such things as poor seed, noxious weed infested material etc., are able to deflect the most of the prohibited materials to states without such laws. Let me relate a few instances. Nebraska has no vegetable seed law, while most of the surrounding states do and consequently, we are on the receiving end of much low germination mixed variety vegetable seed. Mr. Yost of Kansas has reported that many cars of field bindweed infested oats which cannot legally be sold in Nebraska except for processing, are being diverted to Kansas where they can be sold as grain, seed, or feed without processing. For the past two years, several lots of hoary cress infested sweetclover seed which is prohibited from sale in Nebraska has been sent to the State of Wisconsin where it can be sold.

Could not a relatively uniform law and a code of procedure for law enforcement among the several states be adopted to eliminate this shunting from one state to another of undesirable materials? The incentive for shunting would be destroyed if all the states in a region got together and adopted measures prohibiting the sale or movement back to farms of noxious weed infested seed, grain, hay, or other materials which had not been processed to remove or destroy the noxious weed seeds or plant parts present.

Noxious Weeds on a Regional Basis

A study of the noxious weed provisions of the states represented at this meeting revealed that there is a surprisingly close agreement on weeds designated as noxious and a serious detriment to agriculture. Field bindweed heads the list by being a prohibited weed in eleven states. It has been coming up fast in the past several years, as its seriousness is being more widely recognized. Quack grass and Canada thistle are universally regarded as noxious, but many states list them as secondarily noxious and their seriousness does not rank with the new upstarts, hoary cress, leafy spurge, and Russian knapweed, which, are either prohibited or primarily noxious in every state that has revised its list of noxious weeds in recent years. All six of these weeds are distinct threats to production and could be declared noxious throughout the entire region.

In closing, I would like to say that any well balanced weed eradication program must have an actively enforced control program to prevent the movement of seeds and plant parts to places where new infestations can become established. The normal flow of seed, grain, hay, or other farm products, from farm to market or between states should not be dislocated, but the movement of any infested materials back to the farms should be legislated against unless the materials have been processed to remove or destroy the noxious weed seeds present.

Uniform noxious weed control laws and uniform codes of procedure are a practical necessity among the several states of a region to effectively check the spread of these detriments to efficient agriculture.

The enactment of a Federal Weed Act would perhaps provide additional means of control of interstate movement of noxious weed infested materials, but it seems to me that the states of the North Central region should first get together and unify

their own state programs and codes of procedure for control. When they have correlated their programs and unified their approach, the enactment of a Federal Weed Act then would be of assistance in finally eliminating the noxious weeds.

Mr. Everson: That was a splendid discussion. Now we have come to the time for open discussion.

Mr. Ball: I didn't have time to speak further about this, but last year we invited the seed officials to our Western Conference. Since the weed and seed work are so closely related, we are now having joint meetings of the two groups. Last year, Mr. Thornton suggested that we adopt a uniform primary noxious weed list in the Western States.

Mr. Thornton: We set up a list of ten noxious weeds. This list was adopted by the states of the Western Conference.

Mr. Everson: Could you name them?

Mr. Thornton: I don't believe I could name all of them off hand.

Mr. Everson: Does anyone else have anything to offer?

Mr. Lunz: I might suggest that we would be glad to get more of the alfalfa seed infested with hoary cress. We can purify this seed by using our combinations gravity machine.

Mr. LaPine: Mr. Chairman, I happen to represent a seed firm, and there are one or two things that I would like to verify. First, I feel the cooperation of the seed trade should be included in the making up of new laws. The seed trades are anxious to get good laws, because they have played with poor laws so long and in cooperating they can also assist in getting uniform laws. It is my duty to see that the seed of Dickinson Seed Company is properly tagged. It is a problem with so many states and their different laws. It is costly. We are anxious to cooperate. We realize that a good law is to our advantage as much as to the farmer. Another thing is that the seed law should carry enough appropriation to take care of the administration. The idea of having tags, licenses, etc. is wrong. I think the administration should supply the funds. I think uniform laws are vitally important.

Professor Pavlychenko: I would like very much to mention one thing from my experiences in Cadana and from my listening to all the previous addresses here that I think we are all faced with more or less the same situation in regard to weed problems and the way we tend to it everywhere. I think that everywhere in Canada, the United States, and in Europe, we are faced with the same situation. We have a big problem. I was impressed by the statement made by Dr. Keim that the welfare of the state depends to a large extent upon the measures to which we can control our weed problem. The weed problem, in spite of the great losses still remains. Everybody is talking about it, but nobody has a way of approaching it.

It is my frank opinion that until we can allocate weed control to a definite man of each institution, or adapt a division of the Department of Agriculture, until that time, we will be meeting at conferences of this kind and advance very frank and sincere suggestions but we will not get very far with the work. The weed problem, in view of its greatness, should be attended to systematically the way other great

problems are attended to in agriculture. I notice in correspondence that several states in the United States did establish weed divisions with definite men in charge and with a definite staff in charge. Weed problems in my opinion should always consist of parts. The weed research should be at the base of it so if an extension man comes to a farmer to talk on weeds, the farmer cannot help but feel that the man is talking sense to him, is talking facts, because he has a solid background. At the present time, he has no way of proving it. The second part is that the administration should rest with the weed division in each state. The administration should see that the research work is going on and has sufficient funds. Administration of weed problems should consist of utilizing the results of research. It should be put through the mill of very thorough criticism and what is good enough should be put under the particular state to which it is adapted. Different states will have different problems and solutions.

The third part should consist of very strict and intelligent supervision. One man here made the statement, and which I copy, that over a period of years there was not recorded one successful case of eradicating noxious weeds where no supervision was made. It is not because the farmers are lazy or because the farmers do not care. It is because the farmers do not know how to eradicate noxious weeds. If they had intelligent advice to go on, they would be only too willing. Work half done is just as good as work not done at all.

The fourth part of any program should be a communal approach to certain weeds. Certain weeds can be eradicated effectively, quickly, and more cheaply if state machinery or township machinery is employed and one man is specially assigned to take over the responsibility. If we could get together and form a definite program, I am sure it would be a success.

Mr. Everson: Thank you, Professor Pavlychenko.

Mr. Swenson: I know that it is not the desire to continue with this program any later. However, inasmuch as the committee reports are the very last on the program, and plans for the future are last, I move that Mr. Yost's committee on Plans for Future Meetings be designated as a nominating committee and bring in a slate of nominees in the event of a permanent organization.

Mr. Everson: Is there a second to that motion?

Motion was seconded and carried.

At this point the temporary secretary made a few remarks in regard to the publishing of the proceedings. The suggestion was made that perhaps an editing committee should be appointed to assist in editing the manuscript.

Mr. Schrader: I would like to make a motion that Mr. Klatt and Dr. Keim assist in editing the report of proceedings.

Motion seconded and carried.

Second session closed.

BANQUET PROGRAM

Toastmaster - Mr. W. W. Burr, Dean, College of Agriculture, University of Nebraska.
Music - Union Pacific quartet.
Welcome - Mr. Walter E. White, Agricultural Commissioner, Omaha Chamber of Commerce.
Address - Dr. M. A. McCall, Head, Division of Cereal Crops and Diseases and Assistant Chief, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, Washington, D. C. (Printed copy of main address follows banquet program.)
Conference Personalities - Mr. George Porter, Draftsman and Artist, Nebraska State Department of Agriculture and Inspection.
Readings - Dr. Earle L. Whitford, Oldbury Electro-Chemical Company.

Committee meetings followed the banquet.

A GENERAL LOOK AT THE WEED PROBLEM

Dr. M. A. McCall
Head, Cereal Crops and Diseases and
Assistant Chief, Bureau of Plant Industry Station
U. S. Department of Agriculture

Most of what I will say may seem trite to you who know weeds, not only from the ground up, but also deep into the ground. It may, however, demonstrate and emphasize to you men on the firing line the necessity for putting more punch into one of your more important, if less pleasant duties, that is, the education of the administrators concerned with your job.

First of all, I wish to congratulate those who are responsible for calling this working conference. It is a truly significant occasion. It emphasizes not only the great importance of weed control in our agricultural problem, but also the intelligent determination of those responsible for weed control to make operations truly effective. The discussions which are taking place emphasize the advantages of an interchange of experience, and even more the necessity for still better information as to methods and procedures to do the job as it should be done on a practical basis.

The war has brought changes in the weed picture and new problems that must be faced in our post-war agriculture. Many of these changes are readily apparent to those of you who have the responsibility for carrying on weed projects, either research or regulatory, during the war period. Other changes may not now be recognized by any of us, but will show up later. It won't hurt to mention a few we do see. The shortage of labor has made it impossible for the farmer not only to maintain the clean-up programs already started, but also to prevent reinfestation of lands once cleared. It is hard to know the total loss in headway resulting from this cause in the Central States, but more than one county weed supervisor has been deeply discouraged on seeing the efforts and productive results from many years' work almost nullified. The shortage of chemicals, especially sodium chlorate, which came just when more chemicals could have been used to make up for the labor shortage, has added to difficulties. Again, the shortage of new machinery has hurt weed programs as it has every other farm activity, though farmers have shown extraordinary

ingenuity in getting along with what they have. Correspondingly, in weed control research it has been necessary to curtail all along the line, and it has been possible to keep going only those projects most productive of immediate results and which the research men could carry forward with their own labor.

Another most serious item handicapping weed control has been a general slackening of controls on the dissemination of weed seeds in grain and forage feeds and in seed for sowing. Under the compulsion of feed shortages, scarcities of seed stocks, high prices, and pressure for maximum production, it has been all too easy to persuade most sincere folks to accept almost anything that looked like seed or that had the appearance of a livestock feed. This has been true even of agencies normally expected to guard against such lapses in good agriculture. In some areas, there have been extremely serious results from bringing in low quality feed grain full of weed seeds, without any regard to the future dangers involved. More than 450 cars of low-grade feed grain badly infested with Canada thistle, quack grass, and other weed seeds, were brought into this country from Canada, and in many cases the grain was fed on farms without grinding or otherwise devitalizing the weed seed. It is difficult to believe that this disregard of our future agricultural welfare was necessary, when such feed could have been made innocuous by readily available means, granting as we do that the feed itself was badly needed. The evil consequences of this careless disregard of good agriculture will be felt beyond our lifetimes.

Recognizing the many ways in which the war has affected weed control adversely, one cannot but be impressed, on the other hand, by the progress made in all areas in continuing the good fight to bring weeds under control despite discouragement and handicap. You who carry the burden of responsibility should be congratulated on the results achieved in the face of many obstacles.

The war, however, in the long-time sweep of events will soon be history, and there is nothing to be gained by recounting losses resulting from the war except as this may help us to recognize our problems and to plan for the future. The virtual disappearance of bindweed in some counties where it was once abundant is most encouraging; and if we happen to be feeling quite optimistic we might even be able to persuade ourselves that when things clear up it shouldn't take too long to clean up that part of the job. There seems little chance for any such happy ending at any early date. In the first place, bindweed is only one of at least thirty weeds which are truly "noxious", in every sense of the dictionary definition of that word. Not all of these weeds occupy as much land as bindweed has invaded, though at least one of them, Johnson grass, probably occupies an even larger area than bindweed ever did. Some of these weeds, for instance Russian knapweed, white top, and poverty weed, to name a few, seem to be even more difficult to kill than bindweed, and it may take a lot of hard work by our research men to find effective methods that will take less time and effort than present information makes necessary. That would only be repeating our experience with bindweed, however. Altogether there remain, as nearly as we can estimate, more than 2,000,000 acres of good agricultural land virtually out of production because of noxious weeds. Certainly the job is far from finished when a problem of that magnitude is still on top.

The interests of this group cover a wide variety of agricultural types. There are distinctive weed problems for practically each one of these types. As an example, most of us probably would think of field weeds as the most serious weed pests of irrigated lands. In some areas they are, but aquatic weeds that grow in ditches and other shallow water are by no means far behind. The Bureau of Reclamation

spends more than 100,000 dollars a year dragging weeds out of the irrigation canals and drainage ditches under its jurisdiction, and even with this expenditure considers the job poorly done. The Bureau of Reclamation has supervision over less than one-seventh of the irrigated land in the United States, so the irrigation ditch aquatic weed problem is one of some magnitude. In addition to the irrigation ditch and reservoir aquatic weed problem there are other aquatic weed problems of public importance. In the bayou country of Louisiana and along the St. John River and elsewhere in Florida incredible masses of water hyacinth block not only minor streams and drainage ditches but navigable streams as well. For 30 years the War Department has waged a losing battle against these pests. The Office of the Chief of Engineers spends upwards of a quarter million dollars each year merely to clear small temporary channels through the weeds so that some navigation of a sort can be maintained. The solution of this problem is a real challenge to ingenuity. City reservoirs, private lakes, dam sites, fish hatcheries, and water supply systems have aquatic weed problems of equal extent and importance. They tie back to the same requirements for control as our farm irrigation water weed menace and should receive attention from public weed control agencies.

In irrigated sections there are dry land as well as aquatic weed problems. In one of the oldest reclamation projects in the West we are told that one-eighth of the cultivated land has been out of production for a number of years because of white top, morning glory, and similar weeds. Another one-eighth is so badly infested with these weeds that it soon will be added to the total. These lands cost the people of the United States a large amount of money to bring them under water, and hundreds and even thousands of settlers and their families have spent their lives and resources to make what they hoped would be productive farms out of this and similarly infested land. Their lifetime of effort has been wasted in all too many cases because these vicious weeds have not been controlled. Much of the trouble starts and is maintained by ditch bank infestations that no one orginally considered himself responsible for. The whole complex of weed infestation on irrigated lands in many cases requires special attention and clear definition of responsibility for effective control, another challenge to both research and control agencies.

Another most serious weed problem is that of brushy shrub-like weeds infesting range and pasture lands throughout the United States. According to our by no means complete records, there are 39 kinds or species of shrubs or small trees, each of which infests some 10,000 acres or more of otherwise good pasture or rangeland. Some of these infestations run into millions of acres. Examples are: mesquite and cedar in Texas; gorse, blackberry, and Scotch broom on the Pacific Coast; saw palmetto along the Gulf Coast; sassafras, persimmon, and buckbrush in the Ozarks and Kentucky; and sage brush and shinnery oak in the breaks of western Oklahoma and adjacent Texas.

Altogether some 5,000,000 acres of land that should be in grass are estimated to be occupied by these worthless shrubs.

The control of weedy shrubs is only a minor phase of the range and pasture weed problem. Pastures have always been a major breeding ground for farm weeds. We are now coming to realize, however, that pastures are an important part of good farm plans and operation, and that to return the profits they are capable of yielding weeds must be controlled. How to control and eliminate the wastes and losses from weed infestations on the some 300,000,000 acres of farm rotation and permanent pastures, let alone the even larger areas of rangelands, is a challenge to all of us.

Another segment of the over-all weed problem in which we all have a vital interest is that of weed infestations on highway and railroad rights-of-way. This has been noted today by many of the speakers. Both of these, if neglected, serve as primary sources for farm infestation. Railroads have been interested in weed control because of the fire and accident hazards from weeds and the generally unsightly appearance of excessive weed growth. They are also conscious of their obligations to their agricultural clientele. Highway maintenance engineers have equally definite reasons for controlling weeds, and are equally conscious of their obligation, but too often do not have means for doing the job. Neither the railroads nor highway officials, however, in spite of the best efforts of their best engineers have solved their weed problem satisfactorily. Perhaps this is partly due to the fact that they are engineers and approach the job too often as engineers and not as agronomists. It is probably true that they might have greater success with their weeds had they more benefit of advice from men who know the plant side of the problem. Be that as it may, the problem has had attention from a good many able men, and it is by no means solved. The railroads are trying to control weeds on some 300,000 miles of track, using salt, sodium arsenite sprays, sodium chlorate, crude oil, flaming, etc., all of which are expensive and not always too effective, or at best may develop accessory problems such as soil erosion which must be controlled. The railroad and highway officials have a right to expect our assistance, since they pay taxes, and their failure in turn menaces the farmer. All of this raises still another serious problem common to most of the Western States. That is how to control weeds on public lands. As time goes on this problem is quite likely to extend to the whole country. It is a challenge to all of us.

A side-line use for herbicides, which some of you may be called upon to service as experts in herbicidal action on plants, has to do with defoliating certain plants to facilitate harvesting operations. Mechanized picking of cotton offers large opportunities to reduce costs. Leaves interfere with operations and increase waste and trash in the picked cotton. By spraying or dusting the cotton plants with an herbicide, the leaves can be killed and removed from the plant, leaving only the bare stalks and the cotton bolls for the mechanical picker to work on. Potato growers in some areas follow the practice of spraying potatoes with an herbicide in advance of harvest to kill the vines. This is done to check the late blight disease, to prevent the over-development of tubers, to permit earlier harvesting at a time of higher prices, or for any of several reasons. Men skilled in destroying weeds with herbicides should be able to render service in this type of herbicidal plant control.

One phase of the over-all weed problem which is badly neglected is that of annual weeds. They, like the poor, are "with us always". No accurate estimate has ever been made of the net cost of damage from annual weeds, but certainly they are far more serious in total than even our most noxious weed species. The very insidious and ofttimes inconspicuous attack makes them doubly dangerous. Some, adopting a semidefeatist attitude, even argue that at least in some cases annual weeds have certain values and act as Nature's means of conserving the soil. This may be partly true, particularly when we follow poor cropping sequences and neglect adequate soil cover, but there is certainly no merit in propagating worthless weeds merely to lessen the evils of slovenly farming. In most cases such a philosphy leads to a result worse than the sum of the two evils alone. Consider, for example, puncture vine, which in the last 15 years has spread eastward and northward from southern California until in places it covers the earth with its miserable spiny fruits. The world has no conceivable need for puncture vine. Something must be done to control its spread. Downy bromegrass has some value for early spring grazing, but by the middle of June it has become a fire menace of frightening proportions over vast areas in Mountain and Intermountain West. We could do without it. Fanweed certainly

costs our farmers an immense sum with no return. We would like to be rid of this pest also. Yet in spite of general agreement that all of these and the many other annual weed pests should be brought under control, no one has yet devised any really effective way to do it. It looks like some of us should tackle the job in earnest.

Obviously, in a short time no one could review even a beginning of the weed problems that confront us. What has been said, however, may serve as a background for considering what can be done about the matter.

We have only to think back to the somewhat apathetic public concern about weeds which existed in 1934 to realize the progress that has been made in the few years since that date. Happily, general public attitudes on weed control now are definitely less passive. Certainly there is a growing weed consciousness, or an improved weed psychology, on the part of farmers and of local, State and Federal officials. It may be expected that improvements in control methods will further implement an even more active public interest. While farsighted individuals have long been aware of the weed menace, it has been little more than a decade since the public began really to be aware of weeds in this country. The good start with encouraging results in both research and control activities gives every reason to expect equal or greater progress in the next 10 years. Incidentally, at this point I want to compliment our hosts here in Nebraska, where Dr. Keim and Mr. Klatt have done a grand job in carrying the ball and in rousing public interest. Others have given yeoman help, but Dr. Keim in particular really brought the converts down the sawdust trail and the sinews of war into the collection box.

While we may be greatly encouraged by improved attitudes and by actual progress in control, we must not lose sight of the fact that final success depends on making weed control and integral part of day to day operations on each and every farm. Research may show how and when to do the job so as to get best results most certainly and most cheaply. Control officers may spark the over-all program and may handle that part of the work that is out of hand or that is a public responsibility. But in the end, continuing control depends on each individual farmer on his own farm. Everything that we do in the development of methods through research or in the organization of control programs should be based on the fact that in the end the farmer must do the job.

Recognizing the part which the farmer must play in weed control, special attention should be given to factors that will help him most effectively. Cultivation and other tillage operations, for example, will always occupy a prominent place in the picture. Great advances have been made in these operations through use of tractors and larger units, but the principal implements work much the same and our plan of work is much as in our fathers' day. Recent engineering studies suggest that a great deal can be done to streamline some of these rather simple and fundamental operations in a way that can greatly improve their efficiency, may modify the kinds of tillage machinery offered for our use by manufacturers, and in the end change concepts and attitudes toward cultivation on the part of farmers.

Knowing the ingenuity of our people, it would be most surprising if we do not relatively soon have kinds of machinery for weed control that are unknown today. As an example, a flame throwing machine attached to a tractor has been used successfully to burn the weeds out of young cotton rows at a speed of 5 to 6 miles an hour and without injury to the cotton. The machine also works well in sugar cane, and with adjustments may ultimately prove useful for other crops and situations as well.

Some day the blast of the weed burner instead of the clank of the cultivator, may be heard in some parts of our land. Other implements for weed control likewise should be expected.

Associated with the use of improved machinery and mechanical methods should be the use of crops better adapted to weed control, and better crop rotations and sequences working to the same end. The tremendous expansion in soybeans during the war, while it may not be maintained at present high levels, is certain to remain in part. Soybeans properly balanced with other crops will have a definite effect on farm weed control. The almost universal adoption of hybrid corn, with its high yield potentials, tends to encourage better care with better weed control as a corollary result. Better livestock, better crop varieties, all tend to raise the standard of operations, the beautiful stands of uniform corn, for example, rousing the pride of the grower and emphasizing the undesirable presence of cockleburs and ragweeds.

Always there is that pot of gold at the end of the rainbow, some mystic rite that will eliminate the weeds at a wave of the hand, or at most by sprinkling on some magic chemical that will do the job without more ado and without other harmful effects. Since Adam was cast from the Garden of Eden under the Divine sentence that he must earn his daily bread by the sweat of his brow, his descendants have been looking for some way to ease the penalty. In weed control for a time we looked hopefully toward the chlorates, arsenicals, acids, borax, some one or the other, as a possible answer. These have proven useful in certain situations, but each has its limitations and disadvantages, and none of them have removed the sweat or the labor from the main job.

This, however, is no reason for discouragement, nor is it proof of the negative philosophy that fleas are good for a dog or weeds for man. As a matter of fact, the present condition of world affairs suggests that all of us might be better off if our minds were more centered on the fact that we are men rather than otherwise.

In line with the old axiom that it is always darkest just before the dawn, there is some reason to believe that we may actually be on the verge of finding our magic weed control formula. All of you have heard in one way or another of those chemical substances in plants called hormones or growth regulating substances which in infinitesimally small amounts regulate plant growth. One might be inclined to expect that if a "little" of such substances is good for plants, "more" would be better. Actually in this case "more" is disastrous, and instead of being stimulated to better growth the plant is killed. And the surprising thing is that "more" is still a very small quantity as we usually think of herbicides. And even more surprising is the selectivity in herbicidal effect of the very limited number of the growth regulators so far tested. Some species are killed, others are not affected to any extent. Preliminary work with bindweed indicates this weed as quite susceptible. Likewise when the growth regulator is applied to turf, narrow-leaf plantain and dandelion are killed, and the grass is not injured. These results are at least suggestive of interesting possibilities.

I wish, however, to emphasize that the work on growth regulators as weed killers has not reached a stage ready for immediate widespread use. Many details remain to be worked out. There are many of the regulator compounds yet to be tried, some of which may be better than those now being tested, and also different in their selective action on different weeds. Yet the results so far obtained hold promise beyond anything so far known in the herbicidal field. The quantities required are small. There seem to be no residual effects on the soil. The selective properties open up possibilities for use on weeds in growing crops, pastures, meadows, lawns,

road rights of way, airport runways, etc., that presently used herbicides do not possess. Of course, there may be difficulties we now do not see, but even so results so far obtained suggest the kind of herbicidal action and other attributes we have always dreamed about, and now may even hope ultimately to find in the infinite number of organic compounds available for trail.

Even though ultimately we may find an ideal herbicide, it is my own belief that our primary reliance in weed control should and probably must depend on preventing and controlling infestations through good farming. Timely and adequate tillage, weed-free seed, good rotation and crop sequence, quarantine against weed contaminated outside produced feed and forage, must be our chief reliance. Other measures can be only supplementary to plug the holes that are missed.

In this connection I wish to mention one item in weed control, which is most difficult of solution, yet which for that very reason should receive special attention. The increase in farm weed infestations in this country from feeding weed seed contaminated emergency feed grains brought in from Canada, has been noted. That seems a rather striking example of the damage from such carelessness, yet it is not a drop in the bucket when compared with weed seed moved from place to place in this country in our own feed grains and hay. The devitalization of weed seeds removed in cleaning farm seeds before such screenings can be shipped in interstate commerce is provided for in the Federal Seed Act, but there is no protection against the interstate shipment of other weed seeds contained in feed grains or hay. Proposals have been made for drafting legislation to control interstate shipment of feeds so as to prevent this movement of weed seed from state to state, but the difficulties of devising what seemed to be adequate yet reasonably enforceable regulatory procedures blocked this highly desirable step. State weed control officials should give this problem careful study, and bend every effort to working out ways of doing this job on a feasible basis. Without control over this menace there is a serious question whether any real weed control can be attainable.

In the beginning of this rather rambling jaunt through our big national weed patch, I noted the emphasis which all of your discussions have placed on the need for more information. Additional research to meet this need is badly needed. A relatively little money spent in research can save many times this amount in control operations and can insure that the job will be done more effectively.

Your research committee is to bring in a report with specific recommendations on research, so I will not encroach on their prerogatives, but will try to point out a few principles that in my opinion should operate in developing the research program.

In the first place, the primary purpose of weed research is to provide workable and practical methods that can be used by the farmer and control agencies to control weeds. There must be complete coordination between research and action on farms or wherever weeds are to be controlled. Experience in controlling weeds shows the deficiencies in existing knowledge and methods, and the mending of these breaks in our armor should be the function of research. The research man should work closely with control officials and farmers to learn problems at first hand, and to see how methods devised from research operate in action. Control officials in turn should be in close touch with research in order to apply its findings as quickly and as effectively as possible, and also to suggest on the basis of experience what items need additional research attention. As I see the problem of integration, this

should not be merely a matter of casual though friendly contact and suggestion, but rather one of definitely recognized mutual obligation based on good will and a single-minded determination to do the best possible job for the public whose servants we are. The discussions and recommendations of this meeting should serve most effectively to implement such integration.

I also believe that the research program should deal in basic principles, which can serve as a foundation to devise methods for meeting whatever situation may arise. All of us, I think, will agree that the accomplishments of the cooperative bindweed research program have been substantial. I believe that this has been possible because the program stuck to basic principles, and recognized that methods to be devised from these principles must be fitted into the usual operations of good farming. By sticking to this somewhat single-track program, we have learned a great deal about bindweed, and have been able to use this information in devising workable practices to control this vicious pest under at least some conditions. More, of course, needs to be done to cover all situations. We have also been able to develop some general principles of rather wide application to all similar weeds, to a degree at least that they can serve in organizing research on the other weeds so as to get results more quickly and surely. I believe we should follow the same general policy in all weed research.

And finally, I would again emphasize that the final criterion of effective weed control is the smoothness and efficiency with which it fits into usual farm operations as one part of good husbandry. We must remember that weed control, while extremely important, is only one feature of good farming. Improved productivity, erosion control, also must be carried along with weed control as essential parts of the whole. On the other hand, we can comfort ourselves with the thought that in the main everything that contributes to better farming also contributes in some degree to weed control. And as education and training are necessary to attain these ends, so also should they be an essential part of weed control operations. Fact finding, education, application, make up our collective job in defeating the weed menace.

FIRST SESSION - November 17

Professor J. W. Zahnley, Department of Agronomy, Kansas State College, presided over the first session.

Mr. Zahnley: We will now proceed with the research part of this conference. Our first speaker is Mr. A. H. Larson of the University of Minnesota who will discuss "Habits and Characteristics of Weeds."

HABITS AND CHARACTERISTICS OF WEEDS

Mr. A. H. Larson
Division of Plant Pathology and Botany
University of Minnesota

Weeds are among the most successful plants especially when judged upon the basis of their abilities to perpetuate their own species and take possession of the arable land. In spite of the efforts of man to make crop plants grow where weeds do and the continual competition of still other plants for a place in the sun, they continue to thrive. There must be reasons for their abilities to continue in spite of opposition. It is obvious that any attempts to control or eradicate them must be dependent upon a knowledge of their structures, and habits or personalities. Any attempt to carry out weed control laws without a knowledge of these and a solution for them, would be very futile and open to just criticism. This field of endeavor is relatively new. The public has suddenly become weed conscious. Little progress can be made until the biological foundations of weed control are better known. It is with this in mind that I proceed.

It is, or should be, common knowledge that when the first settlers came to this region to till the soil, there were no weed problems. They broke up the prairie sod, grubbed out the forest trees, and grew crops that were free from, not only plant diseases and associated pests, but free from the competition of weeds. The prairies were covered with that type of vegetation which through thousands of years had the abilities or had developed them, which made that vegetation able to persist in a region of extremes of temperature, prairie fires, protracted periods of drought and rather sporadic rains which usually penetrated to rather limited depths in the soil. For this, hardy plants were required that could stand the dessication of the low temperatures and the hot dry weather; plants that could conveniently retire into a dormancy on short notice or those that could make a drink of water go a long way. These were largely grasses with their shallow rootstocks, corms, bulbs, and extensive soil binding roots, their ability to go quickly and conveniently into dormancy and recover when "happy days were here again." They had more or less permanent root hairs, and their leaves could involute or convolute to cut down excessive loss of water.

In the woodlands were plants that had to get along under a different light and moisture economy. The energy of the sunlight had been absorbed by the tree leaves, to a great degree, and the plants on the forest floor needed chlorophyll that was able to screen out enough energy from the meagre supply that remained, to provide for their needs. Also since the atmosphere near the forest floor was usually moist, there was no need for a waxy coating or special leaf structures to conserve moisture. Hence when the forest cover was removed they were unable to persist in direct sunlight with high temperatures and quick and excessive losses of moisture.

The results in these two situations, the prairie and the forest, were the productions of few if any native plants that would be aggressive competitors with cultivated plants, under more or less intensive conditions of crop husbandry. The prairie plants were shallow rooted opportunists that smiled when there was a proper balance of sunshine, warmth and moisture, and no disturbance of their root systems. They fitted the situation. In the woods were the shy, thin-skinned plants that could exist only in reduced sunlight and a more or less plentiful and constant water supply. These surely did not offer much resistance to the ways of man when he removed their protection, the forest cover. How these plants came about is difficult to say. Perhaps they set out to solve their specific dilemmas, but it is more likely that they were the culmination of centuries of change and the survival of the fittest under the existing conditions. It is difficult to see how any of the native inhabitants of these two habitats could be seriously considered as being weeds under good farming practices except under very unusual conditions, as in the case of the cactus when it arrived in Australia. If any of them had serious weedy propensities, no doubt they would have thoroughly cloaked the surface of the earth and required more than mere plowing of the lands to spell their doom. The comments of the Indian of the prairies when white men broke up the native sod, is well known but was not heeded. It took only a combination of drought and wind to bring out the dust bowl.

The plants that can seriously be considered as being weeds are those which since prehistoric time have been associated with cultivated crops and have learned to get along with these cultivated crops, and the conditions under which they grew. Incidentally, they no doubt have been selected and reselected by farming practices until now the most persistant have become problems in all comparable areas of the civilized world. Very few of our crop plants are native to the Western Hemisphere. Nearly all of our weeds have been introduced very likely with the seeds of the crops with which they had been associated for ages. Weeds are among the most cosmopolitan of plants. This ability to persist in spite of efforts to eliminate them, can only be associated with the composition or modifications of the parts of the weedy plant namely the roots, stems, leaves, flowers, and fruits or seeds. These modifications may be in relation to ecological conditions such as climate, wind, soil, and plant associations or to farming practices and livestock. It may be well to discuss these in more detail.

Even casual observation is sufficient to show that the distribution of weedy plants is more or less associated with definite ecological conditions, plant associations, land utilization, etc. There are weeds which are associated with soil conditions; as Russian thistles in dry soil, sand burs in acid usually sandy soil, and sheep sorrel in low humus and acid soil. Wheat and other comparable cereals have their associated weeds. Clover and alfalfa have theirs. Annual crops permit some to grow that cannot exist in perennials. Pastures, especially permanent, have their associated weeds, which in turn may be influenced by the animals pastured as well as the ecological conditions of the pasture, and to a great degree by the makeup of the farmer. Some weeds, all around fellows, appear to be at home in most any association or location. Then there are those that have structures that especially fit them for vegetative, in addition to seed reproduction, such as: rootstocks in quack grass, hedge bindweed, etc., bulbs and bulblets in wild garlic, stolons in goose tansy, Bermuda grass; tubers in artichokes and yellow-nut grass, fleshy roots in burdock and other biennials as well as in wild four o'clock, deep storage roots in field bindweed and leafy spurge, etc. These are just a few of the phases of the lives of weeds that must be considered in attempting to find a solution for their control. It may be well to elaborate a little on some.

Many weeds are influenced by their ecological conditions. Horsetail, Equisetum arvense, is found only in acid soil. Usually the acid soils are the highly leached sandy or clayey soils or the soils formed from an acid or granitic base. Close wet soil with poor air circulation are acid. High lime or neutral soils usually are more favorable to other forms of weeds mostly broadleaved. The amount of moisture present in the soil also influences the type of weeds that are encouraged. Some plants are very definitely limited by it while others can compensate for its lack by having hairy exteriors, waxy leaves, and the ability to either drop superfluous leaves or roll them up. Wind too may influence some plants especially in their distributions. This is very evident in the cases of Russian thistle and Canada thistle when their seeds are carried long distances by the wind.

Most of our worst weeds have come from the homes of our cultivated crops. Corn cockle and chess have been spread in seed wheat because it is difficult to remove their seeds from the wheat and because their seeds mature at about the same time. Many crops allow sufficient time for weeds to mature their seed before harvest time and also make it nearly impossible to remove them. Wild mustard has been a troublesome weed because of this. Black mustard has not been so because its growing season is longer than most cereal crops and thus it does not reseed itself before the accompanying crop is harvested and the land can be tilled. Horse nettle in Minnesota does not grow much until after the first of July. When the corn is laid-by, it grows rapidly and the normal handling of the crop permits it to ripen seeds without interference and to store up food to initiate the next years growth. Frenchweed, since its seeds may germinate either in the fall or spring with most any except intertilled crops, can ripen at least one batch of seeds each year.

Some weeds especially those of pastures have their futures insured by having a bad taste or odor, hairy covering, spiny growths, poisonous properties, or woody texture. Mayweed, yarrow, oxeye daisy, etc. are usually avoided by livestock because of bad flavors and odors. Mullein in pastures is never eaten. It is well supplied with trichomes. Thistles usually go through to fruition and grow uncontrolled because the spines keep the livestock away. In our state a cow that eats water hemlock cannot repeat it. Buckbr sh is rather too woody for forage, but is a very common pasture weed. Weeds whose seeds or fruits have appendages have efficient agencies of spread by livestock.

Then there are weeds that have rather specialized characters that aid them materially in their spread. Cockleburs have fruits that not only have appendages for animal distribution, but the fruits are so light that they readily float on water. Then too, there are two seeds in each fruit, both of which rarely germinate the same year. Also they are rather finicky about the temperature at the time of germination. In addition, the seedlings are quite well protected from being eaten by livestock since during the seed leaf stage they are very poisonous especially to young animals. The number eaten is bound to be rather limited because the hydrocyamic acid they can produce is very active.

Perhaps it would be well to look more closely into the private life of one of our most widespread weeds, Canada thistle. First, this should be called field thistle, Cirsium arvense, since arvense means of the fields. It is an introduced plant from Continental Europe and is a tough number because it was tested out in glacial times by being caught between the glaciers on the North and the Alps Mountains on the South. With such a background it must be hardy. Very likely it came to America in crop seeds at a rather early date. Because animals would not eat it, it could ripen its seeds. Since its so-called seeds are fitted with a pappus

that gives bouancy, the winds carried it broadcast without the need of waiting to be distributed with crop seeds, dropping in fields and openings in the forest. The seeds usually ripen earlier than the crops with which they grow. Livestock do not eat it in pastures, thus permitting undisturbed growth. Quite large quantities of plant food are stored in the root system in the latter part of the growing season. This is at its lowest ebb at the time of full bloom. If prevented from making more at that time and a little later, it is quite easily destroyed in Minnesota. There are very few parasites living on it. There are a few insects and some fungi. Insects usually destroy the late crop of seed and sometimes remove much of the leaves. The fungi evidently inconvenience it very little. In spite of all this lavish care of Mother Nature, there are some loopholes in its armour. It resumes growth in Central Minnesota about the second week in May. For the first month the growth is a rosette. About the second week in June, stems rapidly shoot up to be followed by blooming and the developing of seeds. Up to this time much of the growth is made at the expense of stored food from the preceeding year. This is a vulnerable time for control work, some form of clean cultivation, or summer smother crop growing.

A rather common method of control in arable land is to seed in alfalfa. The thistles must first be reduced enough so that a stand of alfalfa can be gotten on every square foot. Results are not striking the first year. The following spring alfalfa resumes growth about the second week in April and by the second week in May, makes shade for the thistle. Alfalfa should be cut about the middle of June. The thistles are cut at the same time. Alfalfa, because of its habit of producing several crown shoots at this time, quickly recovers. The thistle is not so equipped and so the alfalfa again produces dense shade that smothers the thistles. A second cutting repeats the process. The thistle if it continues to live, does so largely at the expense of reserve food which is much depleted. A couple of years of such treatment and the thistle is gone. This may be a lazy man's way of fighting thistles, but I approve of it.

In the control of farm weeds it is quite necessary to be familiar with the life habits of each before much progress can be made. In other words, we should be familiar with its personality. So far there is too little known about this. What is known is quite fragmentary and poorly dispersed. It should be one of the hopes of this Meeting that we set out to do all we can to learn more about these personalities and recrystalize them into a working form.

Mr. Zahnley: We will now hear from Dr. J. C. Frazier, Department of Botany, Kansas State College on "Root Studies of Some Bad Perennial Weeds".

ROOT STUDIES OF SOME BAD PERENNIAL WEEDS

Dr. J. C. Frazier
Assistant Professor of Botany
Kansas State College

According to L. W. Kephart, 1/ of the United States Department of Agriculture, the most urgent weed problem in the United States at the present time is that concerned with "the persistent, aggressive, destructive, chiefly perennial" species of weeds. He stated that 15 years ago the area covered by these weeds did not greatly exceed 1,000,000 acres, which were rather well distributed and under fair control. In 1930, however, began an unusual series of dry years, and concurrently economic depression settled on the Nation. The first provided conditions highly favorable

for seed production; the second brought a marked increase in farm tenancy and a general reduction in farm care, a combination which gave a perfect opportunity for these weeds to spread.

The studies reported on at the North Central States Weed Conference followed the development of five perennial weeds by means of periodic excavations. The findings included the nature of the root system, the extent of their vertical and horizontal development per unit of time which is designated as so many weeks after emergence of the seedling, and the shoot development at each stage of growth.

Detailed studies on four of the weeds reported briefly here have been published in Botanical Gazette 104: 417-425. 1943 (field bindweed); Botanical Gazette 105: 244-250. 1943 (hoary cress); Botanical Gazette 105: 345-351. 1944 (Russian knapweed); and Botanical Gazette 105: 453-470. 1944 (dogbane); those on the fifth (climbing milkweed) are to be published in an early issue. The data for the first four will be available in a summary article to appear in the forthcoming Biennial Report of the Kansas State Board of Agriculture, reprints of which will be available from that Board (Topeka, Kansas) after July 1, 1945.

1/ Kephart, L. W. 1940
The farm weed problem in America. Imp. Bur. Pastures and Forage Crops Herbage Pub. Ser. Bul. 27: 28-37.

Mr. Zahnley: We have now come to the time for open discussion.

Dr. McCall: Is it true that Russian Knapweed is more difficult to handle than some of these other weeds?

Dr. Frazier: I couldn't say if this is so or not.

Mr. Zahnley: Russian Knapweed is more susceptible to sodium chlorate.

Mr. Timmons: A little later I will give some results that I have found.

Mr. Zahnley: We will now hear from Dr. Willard of the Ohio Agricultural Experiment Station on "experiments with Herbicides in Ohio."

EXPERIMENTS WITH HERBICIDES IN OHIO

Dr. C. J. Willard
Associate Professor of Agronomy
Ohio State University

Borax is the only material which has been used extensively enough in these tests to draw any very definite conclusions, and even here, different soil types, seasons, and weeds might give very different results.

Sodium chlorate remains the standard herbicide, but borax is the most promising substitute that has appeared. For Canada thistle 16 pounds of borax seem fully equal to 3 pounds of sodium chlorate, and on heavy clays in northern Ohio this was true in two limited tests on bindweed. On Brookston silty clay loam at Columbus, it seemed to require more nearly 24 pounds of borax to equal 3 of chlorate for bindweed.

Chlorate-borax mixtures were effective, and could be used if there were any economic advantage in using them. We obtained no suggestion that chlorate and borax reinforced or neutralized each other on this dark-colored highly organic soil.

Species vary much more in their resistance to borax than to chlorate. Borax is of essentially no value on quack grass, and other annual and perennial grasses, including wheat, are highly resistant to it. Alfalfa is highly resistant to borax, but soybeans are highly susceptible.

Borax seems to reach its maximum effectiveness more slowly than chlorate, though the difference is not great. Borax is fixed in the surface soil and chlorate is not, so that there will be more annual weeds, or at least a greater variety of them, following chlorate than following borax.

Borax gives some promise as a soil sterilizer, and tests for this use should be continued. The considerable number of species which are highly resistant to borax constitute the most obvious objection to its use as a sterilizer.

Conversely, a serious problem in the agricultural use of borax as a herbicide is the length of time the land may remain sterile for some crops. This may not prove to be serious, but chlorated land will usually be back in full production before borax-treated land.

Borax is non-poisonous and non-inflammable. Its value for poison ivy should be extensively checked at once. Chlorate is not satisfactory for use in small amounts by city lot owners to kill poison ivy, because of the cost of small quantities and the fire hazard involved. If borax can be used dry to kill poison ivy, it may compete with ammonium sulfamate, to date the most satisfactory herbicide for poison ivy on city lots.

Atlacide was effective on bindweed at least in proportion to its chlorate content, and perhaps somewhat more, but our data do not support a claim that it is equal to sodium chlorate pound for pound.

Ammonium sulfamate and sulfamic acid were nearly identical in weed-killing effect. At best they were not more than equal to sodium chlorate pound for pound for bindweed, and were usually somewhat inferior. The single experience with spring application suggests that they compete best with chlorate at that time. Tests in two previous years on Canada thistle gave the same results as this year in that they were definitely inferior to chlorate for fall application. Since ammonium sulfamate costs more than twice as much per pound as chlorate, and is so deliquesent that it must be applied in the inconvenient and unsatisfactory spray form, it cannot be recommended over other herbicides at this time, except for city use on poison ivy, where its lack of fire hazard and effectiveness recommend it.

Mr. Zahnley: That was a very interesting report. We will now hear from Dr. L. M. Stahler of the Bureau of Plant Industry, Soils, and Agricultural Engineering from Lamberton, Minnesota on "Cooperative Herbicide Trials in Minnesota".

COOPERATIVE HERBICIDE TRIALS IN MINNESOTA 1/

Dr. L. M. Stahler
Associate Agronomist
U. S. Department of Agriculture
Lamberton, Minnesota

During the past three years, a series of cooperative herbicide tests in thirteen Minnesota counties has provided valuable information to supplement the results of work on chemical weed killers at the Lamberton (Minnesota) Bindweed Experiment Farm 2/. The tests were forced upon us by two circumstances. First, our recommendations on use of sodium chlorate in Minnesota, based on long-time trials at Lamberton, were not always giving good results under the varied conditions of soil and climate of the State. Second, the war-time shortage of sodium chlorate threatened to retard the expanding weed control program unless an acceptable substitute could be obtained.

At the time of initiating the first of these State-wide tests, only two herbicides other than sodium chlorate showed any promise in Minnesota; ammonium sulfamate and borax. Ammonium sulfamate, tested at Lamberton as early as 1938, had not proven satisfactory for deep-rooted perennial weeds. Borax, tested in 1940 and 1941 with promising results, was available in large quantities without war restrictions, and it was mutually agreed to test its effectiveness in comparison with sodium chlorate as widely as possible throughout the state. The success of these tests, during 1942, 1943, and 1944, has convinced us that future weed control research should be tied closely to the extension and action agencies concerned with weed control programs.

1/ Cooperators include representatives of the Minnesota State Department of Agriculture, the Agricultural Experiment Station and Extension Service of the University of Minnesota, and the Bureau of Plant Industry of the United States Department of Agriculture. The chemical concerns manufacturing or distributing the chemicals used in these tests provided the herbicides.

2/ Operated as a cooperative project between the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture; Agricultural Experiment Station, University of Minnesota, and the State Department of Agriculture of Minnesota.

Plan of Trials

Selection of locations for the cooperative tests was made with certain specific objectives in mind. The first three of these are important from a research viewpoint; all are important to those interested in extension activities and action programs.

Selection of weed species. As most of the basic research on herbicides has been confined to a few species of weeds, local infestations of other noxious species were included in the tests.

Selection of conditions. Soil types, rainfall, pH of the soil, and topography are special problems in experimental weed control, and procedures were developed to provide data on these points.

Selection of herbicides. Only those herbicides and practices that obviously were feasible and offered distinct local advantages were included in the tests. Each project was kept within a range that allowed direct comparison of data from different locations. Funds, personnel, and available area necessarily controlled this.

Selection of local cooperators. County agricultural agents, county weed officials, and farmers vary greatly in their interest in weed control and their usefulness is in proportion to their interest. Plots were located, when possible, on land of owner-operators.

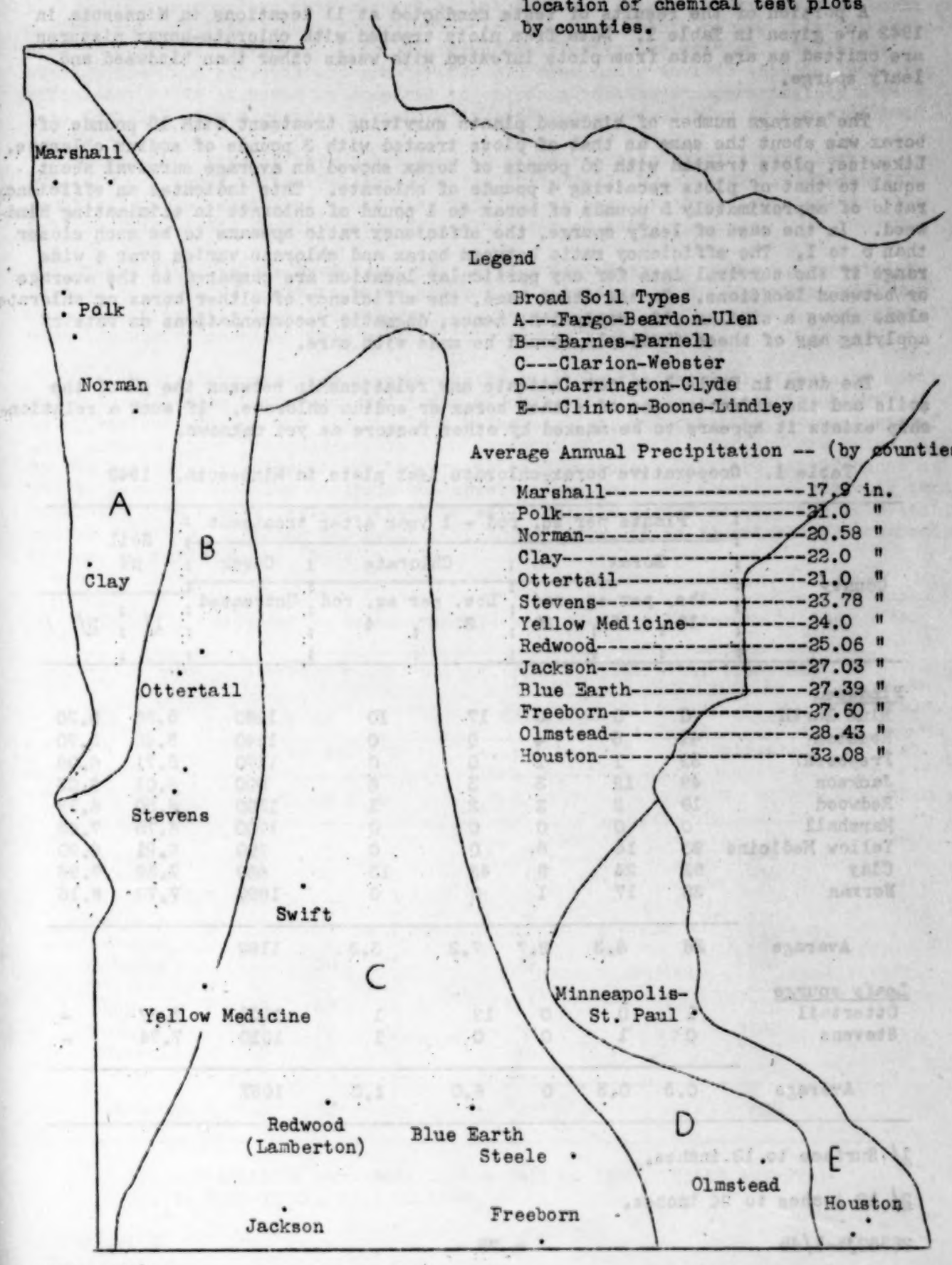
Demonstrational value. Clear marking of projects and availability to main highways increase the extension and demonstrational value of the tests and this was kept in mind in locating the plots.

Location of the test areas is shown in Figure 1. In 1942, uniform experiments using borax, chlorate, and mixtures of borax and chlorate were conducted on nine areas of field bindweed (Convolvulus arvensis L.), one of leafy spurge (Euphoriba esula L.), and one on Austrian field cress (Rorippa austriaca (Crantz) Spach). In 1943 the number of locations was increased to 16, ammonium sulfamate was added to the herbicides tested, and perennial peppercress (lepidium draba L.), perennial sow thistle (Sonchus arvensis L.), and horse nettle (Solanum carolinense L.) were included in the list of weeds treated. The number of locations was reduced to 9 in 1944, retaining only those locations where results had been non-conclusive or unsatisfactory. During 1943 and 1944, additional tests were undertaken combining cultural methods with chemical control.

All plots used in the chemical tests were on square rod in size. Wherever possible each treatment was replicated three times with a fixed, uniform pattern of randomization. All treatments were applied in late autumn and plant survival counts were made approximately one year later.

Soil types varied from acid peat, through sandy loams, to high lime gumbo, with a pH range of pH 4.9 to pH 8.16.

Figure 1. Map of Minnesota showing location of chemical test plots by counties.



Legend

Broad Soil Types
A---Fargo-Beardon-Ulen
B---Barnes-Parnell
C---Clarion-Webster
D---Carrington-Clyde
E---Clinton-Boone-Lindley

Average Annual Precipitation -- (by counties

Marshall	17.9 in.
Polk	21.0 "
Norman	20.58 "
Clay	22.0 "
Ottertail	21.0 "
Stevens	23.78 "
Yellow Medicine	24.0 "
Redwood	25.06 "
Jackson	27.03 "
Blue Earth	27.39 "
Freeborn	27.60 "
Olmstead	28.43 "
Houston	32.08 "

Results

A portion of the results of tests conducted at 11 locations in Minnesota in 1942 are given in Table 1. Data from plots treated with chlorate-borax mixtures are omitted as are data from plots infested with weeds other than bindweed and leafy spurge.

The average number of bindweed plants surviving treatment with 15 pounds of borax was about the same as that of plots treated with 3 pounds of sodium chlorate. Likewise, plots treated with 20 pounds of borax showed an average survival about equal to that of plots receiving 4 pounds of chlorate. This indicates an efficiency ratio of approximately 5 pounds of borax to 1 pound of chlorate in eliminating bindweed. In the case of leafy spurge, the efficiency ratio appears to be much closer than 5 to 1. The efficiency ratio between borax and chlorate varies over a wide range if the survival data for any particular location are compared to the average or between locations. On the other hand, the efficiency of either borax or chlorate alone shows a similar wide variation; hence, dogmatic recommendations on rate of applying any of these chemicals should be made with care.

The data in Table 1 do not indicate any relationship between the pH of the soils and the effectiveness of either borax or sodium chlorate. If such a relationship exists it appears to be masked by other factors as yet unknown.

Table 1. Cooperative borax-chlorate test plots in Minnesota. 1942

County	Plants per sq. rod - 1 year after treatment						Soil pH	
	Borax			Chlorate		Check		
	lbs. per sq. rod			Lbs. per sq. rod				
	10	15	20	3	4	Untreated	1/	2/
Bindweed								
Blue Earth	0	0	0	17	10	1280	5.36	5.30
Houston	41	5	4	0	0	1140	5.45	5.70
Freeborn	32	1	1	0	0	1170	5.71	6.08
Jackson	48	12	3	3	6	600	6.01	6.03
Redwood	19	2	2	2	1	1300	6.50	6.58
Marshall	0	0	0	0	0	1700	6.75	7.65
Yellow Medicine	93	14	6	0	0	990	6.91	6.90
Clay	52	24	8	43	13	660	7.59	7.96
Norman	38	17	1	0	0	1890	7.78	8.16
Average	36	8.3	2.7	7.2	3.3	1192		
Leafy spurge								
Ottertail	1	0	0	12	1	1105	7.67	-
Stevens	0	1	0	0	1	1010	7.74	-
Average	0.5	0.5	0	6.0	1.0	1057		

1/ Surface to 12 inches.

2/ 12 inches to 24 inches.

Table 2 summarizes data secured on ten bindweed locations treated with borax and chlorate in 1943. Data from similar treatments on plots of sow thistle, perennial peppergrass (white top), and Austrian field cress are omitted. While the average bindweed survival was greater for all treatments in 1943 than in 1942, the efficiency ratio of borax as compared to chlorate remains at approximately 5 to 1. Data for 1943 show a greater variation in bindweed survival than do those of 1942.

Since the tests in both years gave poor and variable results with both sodium chlorate and borax in the Red River Valley (Ottertail, Clay, Polk, and Marshall counties), a new series of plots were laid out at each of these locations in the fall of 1944 adding heavier rates of application of both chemicals.

These field trials have demonstrated that different soils may be expected to respond quite differently to borax and sodium chlorate and that the same soil may respond differently in different years. The complexity of the problems associated with the use of chemical weed killers is somewhat bewildering.

The tests have provided an opportunity to study the residual effects of borax and chlorate under different conditions of soil and climate. Biologic checks, using various grasses and legumes, are being studied, and quantitative analysis of soil samples taken from comparable treatments at different locations are being made by the Division of Soils of the University of Minnesota. Data are insufficient as yet to permit a detailed analysis but observations here and elsewhere indicate that borax may have a more lasting effect on soil than the highly soluble and less stable sodium chlorate. Pending the outcome of these tests, borax is not being recommended for use on agricultural land.

Table 2. Cooperative borax-chlorate test plots in Minnesota 1/ 1943

County	Bindweed plants per sq. rod - 1 year after treatment				
	Borax			Chlorate	Check
	Lbs. per sq. rod			Lbs. per sq. rod	Untreated
	10	15	20	3.75	
Houston	540	0	0	0	600
Freeborn	96	78	72	0	600
Blue Earth	7	1	1	0	320
Jackson	14	1	2	0	320
Redwood	1	0	0	1	180
Stevens	124	36	25	29	850
Ottertail	50	48	48	3	735
Clay	188	93	61	116	310
Polk	141	90	56	59	1260
Marshall	53	50	39	40	1410
Average	121	40	30	25	657

1/ All applications were made in the fall of 1943. Plant survival counts made in the fall of 1944.

The investigations have demonstrated the tolerance of certain species of plants to borax in the soil. Quack grass (Agropyron repens L.), on plots treated with 10 or 15 pounds of borax, has consistently been more vigorous than on untreated check plots. Sweet clover has matured seed regularly on the borax plots. Bindweed appears to be more tolerant to borax than is leafy spurge but sow thistle and Canada thistle apparently are more tolerant than either.

At the close of three years of operation of this cooperative project it is believed that most of the objectives of the various cooperators have been accomplished. The research group has obtained data from plots replicated on areas of wide variability; the extension and enforcement agencies have had demonstrational plots available where they were most needed and have had first hand, local information on which to base their recommendations and activities; the chemical companies have had local field demonstrations that have influenced local sales of their products while at the same time guiding their production schedule. From every point of view, the experience has been profitable and we hope that it will be a guide to future operations.

In spite of shortages of labor and equipment in 1944, Minnesota used in excess of 1,300,000 pounds of sodium chlorate and 1,200,000 pounds of borax in carrying on the fight against noxious weeds.

Summary

1. The exigency of the present weed situation demands an extensive as well as an intensive research program that is closely correlated with extension and action agency programs.

2. Minnesota has developed a cooperative working arrangement that aims at local and emergency aid in weed control problems. Activities are guided by results of past basic research and by the practicability of local adaptations. Projects are so designed as to furnish dependable research data as well as local demonstrations.

3. Data from cooperative borax-chlorate tests in different parts of Minnesota in 1942 and 1943 have established an efficiency ratio of 5 to 1, respectively, for these herbicides in eliminating bindweed. When used on leafy spurge, this efficiency ratio appears to be much narrower. Locally, rates of application of borax and chlorate have been established and generally adopted. Effective applications of borax as an herbicide may have long lasting residual effects on the soil, hence borax is not recommended for agricultural land. Residual effects of both borax and chlorate vary greatly between different locations and locally in successive seasons.

4. From a demonstrational viewpoint, the state-wide tests have been effective in adding impetus to the expanding weed program.

Mr. Zahnley: Thank you Dr. Stahler. We will now hear from Mr. L. W. Kephart from the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture in Washington, D. C. on "Chemical Weed Killers after the War."

CHEMICAL WEED KILLERS AFTER THE WAR

Mr. L. W. Kephart and Mr. S. W. Griffin
Senior Agronomist and Senior Chemist
U. S. Department of Agriculture
Beltsville, Maryland
(Presented by Mr. Kephart)

One of the brighter aspects in the post-war weed picture is the probability that new chemical weed killers will be available of a variety and potency which we have not heretofore known. This is a refreshing prospect. Weed eradication, as a science, has always lagged far behind other kinds of pest control in the development of technical aids, and our knowledge of the nature and utilization of herbicides is crude indeed by comparison with the highly intricate knowledge of insecticides, fungicides, germicides, and the like. The reason for this is not obscure. For half a century, trained technicians by the literal hundreds have been studying chemical remedies for noxious insects and plant and animal diseases. Yet, in all that time scarcely a dozen men have had the opportunity to give their full time and thought to the possibilities of chemicals in the control of weeds. As a result, the science of chemical weed control is still elementary and farmers have had available for their use, at least until very recently, only such unimaginative materials as arsenic, chlorate, sulphuric acid, and petroleum oil. In truth, it <u>is</u> time for a change!

The change may not be far away. The war has brought unprecedented expansion to the chemical industry. Chemicals heretofore available chiefly for laboratory purposes or in limited commercial quantities are now available, in almost unlimited amounts. In addition, whole new chemical families, whose members are numbered in the hundreds, and were formerly quite unknown in industry, are now being turned out in tank-car lots by companies who, 10 years ago, were making only a few products and on a small scale. As a result, practically every manufacturer of chemicals is today looking to post-war markets and seeking new outlets for his products. Many of these producers have learned for the first time of the tremendous potentialities in weed control and already a considerable number of companies that never before have been in the agricultural field are setting up research organizations to cooperate with the agricultural experiment stations and the action agencies. For example, one of the largest makers of organics will be left, after the war, with a large manufacturing plant, a beautifully equipped research laboratory, and a staff of highly competent chemists. The company knows nothing about agriculture and has wisely decided not to attempt field tests of its own. It has offered, however, to produce for those of us engaged in agricultural research, any organic chemical, no matter how complicated, which we think has possibilities. Here is an opportunity of which we did not dream 5 years ago, and it earnestly is to be hoped that means will be found to accept it.

To attempt to list the large number of compounds now or soon to be available would be to write a catalogue pages thick. The problem that faces us is how to choose from this sudden wealth. Is there any way that we can determine the relative herbicidal values of these materials except by the Thomas A. Edison method of pickin them off from the shelf one at a time and continuing until we find one that works? If we have to do that we will be a very long time obtaining the answers and weed control officials will be left for an indefinite period in a state of confused uncertainty.

Perhaps there is no way to avoid this laborious method of approach, but it has seemed to us that there are certain chemical groups or types of molecular structures

which, because of their known properties, give more promise for weed killing than do many others. We do not mean by this that we can predict that good ones are certain to be found in these categories. Neither are we sure that excellent herbicides will not be found outside these groups. In fact, one point that we want to stress is that there is no known method outside of actual trial on plants in the field to determine the final herbicidal value of a chemical. All too frequently we find that two chemicals structurally related in some important aspect have widely different effects on plant tissues. Nevertheless, and with these reservations, we suggest the following groups as among those which seem likely to include good weed killers.

Sulphur Compounds

One of the most common chemical substances deleterious to plant life is sulfur in certain of its combinations with other elements. Horticulturists have long known that soluble "sulphide," sulfur, is highly detrimental to foliage and that this is true also of the hydrosulfide, or sulphydryl group. Thus, every orchardist has learned that he may expect injury from lime sulfur spray when used in summer under certain temperature and climatic conditions. The reasons for this are complicated, but include the fact that hydrosulfides are released which inhibit the action of chloroplastic iron and unbalance phytosynthesis. This offers the suggestion that soluble hydrosulfides of the metals and of ammonia are active plant toxicants. Substances of this kind are found in large numbers in the residues of gas works and in petroleum processing and should be available in quantity at a fairly low price. The group has been investigated in a casual way for herbicidal purposes, but there are many interesting approaches as yet untouched.

Going farther with the sulfur compounds derived from coal and oil, we find the thiocyanates and the organic hydrosulfides or mercapatans, such as ethyl mercaptan and phenyl mercaptan. A few good weed killers have already come from these groups, notably the well-known ammonium thiocyanate and Professor R. B. Harvey's sodium xanthate, about which, unfortunately, we have recently heard very little. Again, there are the bisulfites and the metabisulfites, all by-products that can be made cheaply and in abundance wherever sulfur dioxide gas is wasted.

It should be pointed out that extensive studies have been made of the effect of sulfur dioxide upon plants in connection with smelter fume injury, and there is already a considerable basic literature in which the phytocidal properties of this gas are discussed. There seems every reason, therefore, why our weed men should follow this excellent lead vigorously, and we hope that it will be done.

Acetic Acid

Plant physiologists have known for a long time that acetic acid and some of its derivatives are among the most deadly plant toxicants. Very little was done to take advantage of this lead until quite recently when a number of research groups, working independently, found that some of the so-called "hormone" chemicals are amazingly injurious to plants in almost unbelievably small concentrations. Doubtless most of you have read recently of the discovery that 2,4-dichlorophenoxyacetic acid or "2,4-D", is injurious to many weeds, including bindweed. This finding has attracted much attention, and it requires no prophet to tell you that in 1945 there is going to be great activity throughout the country testing this astonishing chemical on weed species. Yet this substance is only one of a very large number of compounds of this general type. What reason have we to think *a priori* that this

is the only one, or even the best, of the group? In fact, there already is some reason to believe that there are propionic and butyric derivatives even more potent than the acetic derivatives. Furthermore, this is only a beginning in the field of acetic acid compounds. How many people know, for example, that monochloroacetic acid and dissolved chloroacetamide, derived from chloroacetic acid or ethylchloroacetate, have amazing power to penetrate corky or oily cuticles as far as the cambium layer and produce pronounced injury to woody structures. This is a fact of tremendous implications in weed control and surely it is a clue which we cannot afford to overlook.

The Aldehydes

Another promising group is the aldehydes based upon formaldehyde, or of any compound with the CHO radical. Recent developments in catalytic chemistry make it appear that compounds of this nature could be available in large quantities and at greatly reduced prices shortly after the war. Best known of these is furfuraldehyde or furfural, the substance which achieved publicity some years ago through the discovery of methods of making it from corn residues. Now it appears that even cheaper methods of production are in sight. If this is true, this group should be carefully investigated because it is based on a versatile radical that produces oxidizing, reducing, and additive compounds as the case may be. It is true that many of the aldehydes are toxic and difficult to handle, but we cannot afford to let this stand in the way of a thorough investigation of the group. Often the disagreeable properties of a compound can be overcome if the useful qualities are sufficiently valuable, as, for example, acetyl peroxide which now can be obtained in a mixture with dimethylphthalate which removes the tendency toward violence in its properties.

Organic Peroxides

The organic peroxides as, for example, acetyl peroxide, just mentioned, present still another avenue of approach because they release nacent oxygen, some slowly and some violently. Because of this they have bleaching properties and any bleach is a material that weed killing people should be interested in.

Formates

Formic acid, which everyone knows in the form of the bee sting, is obviously a powerful substance. There is reason to believe that derivatives of formic acid, as for instance ammonium formate, ethyl formate, ethyl chloro formate, and others, should have herbicidal value or else lead to substances that do.

Oximes

If the above list does not satisfy your investigative curiosity you could go to work with oximes or hydroximes. Biochemists report that these are powerful inhibitors of catalase activity and what could be more promising as a lead toward a useful herbicide?

Chlorinated Hydrocarbons

A number of the chlorinated hydrocarbons, both alipathic and aromatic, have been recommended as weed killers, such as Dr. Bakke's tetrachlorethane. If that is good, why not try hexachlorethane and anything else in this group? The chlorinated benzenes, such as common paradichlorobenzene, the naphthalenes, and many others

offer promise. One of these, at least, the so-called Benoclor, is already in commercial use for treating aquatic weeds. Another, benzene-sulfonchloride, is toxic to plants in a very dilute emulsion. Someone could spend years working on this group alone.

Chlorinated Phenols

Much has been heard recently of another chlorine group, the now well-known pentachlorophenol and its salt, the sodium pentachlorophenate. This is a group that two, at least, of the larger chemical companies would like to develop as herbicides.

The Dinitro Compounds

Finally there is the lead given to us by the dye manufacturers in the so-called dinitro compounds. All of us are familiar with Sinox and perhaps with other salts of dinitro-ortho-cresol. This was one of the first attempts to break away from the traditional type of chemical weed killer and it has opened up a wide field for speculation. Dr. Crafts of California has rationalized very well the reasons for the high toxic value of these compounds and the approach is so logical that we have every reason to expect that manufacturers who are in a position to produce dinitro compounds in quantity will not fail to grasp the opportunity. Already one manufacturer has gone beyond the original material and is preparing to offer the alcohol complex, ammonium-dinitro-orotho-secondary-butyl-phenol.

With this polysyllabic jawbreaker, I shall cease. We have given this list not to display our chemical erudition, but to impress upon you the fact that weed control with chemicals is coming into a new era with new processes and new situations which most of us are really not prepared to encounter. Suddenly we are being offered new concepts of chemical weed control with ideas backed, for the first time, by the tremendous resources of the chemical industry. What are we going to do about it? Obviously something must be done or the country will be subjected to the unhappy spectacle of claims and counter claims made by voluble proponents, each insisting that his own product is best. In such a chemical cacophony, the poor hard-working weed man and his farmer friends may well lose their bearings and become hopelessly confused.

Someone must act as umpire in this situation. We, who are on the firing line, will naturally be the ones to feel the greatest pressure. Are we not the ones who must find the answers? Collectively we must work together to the end that facilities and personnel are available to do this job. The responsibility is squarely upon us. Let us not turn away.

Mr. Zahnley: Thank you, Mr. Kephart. We have come again to the time for open discussion.

Dr. Stahler: Mr. Kephart, I have had some inquiries on hormones as chemical herbicides. I referred all of these inquiries to you.

Mr. Kephart: I know you did, and it may be well to give here, very briefly, the facts about these so-called "hormone" weed killers as we now know them.

For about fifteen years it has been known that certain organic chemicals, chiefly acetic acid derivatives, when applied to plants in very small quantities, produce marked physiological stimulation comparable to the action of hormones in animals and plants. Some of these chemicals promote root growth, others improve seed setting, one is used to prevent premature dropping of apples, and so on. About three years ago several workers noticed that when the concentration of the chemicals was increased, marked injury or even death of the plants sometimes resulted. This immediately raised the question whether these substances could not be used for killing weeds. In 1942 and 1943, preliminary tests were made at the Plant Industry Station, Beltsville, Md., and elsewhere, and in 1944 experiments began in earnest at several places in the Northern United States.

The results have been astonishing. 2,4-Dichlorophenoxyacetic acid, hereafter known as 2,4-D, when used in such weak concentrations as 500 to 1500 parts per million (.05 to .15 per cent solution) was deadly to dandelion, buckhorn plantain, lawn pennywort, heal-all, bindweed, and some others. Bindweed, Canada thistle, poison ivy, honeysuckle, and other deep-rooted perennials have been badly injured if not killed. Broad-leaved plantain, wild garlic, bugle weed, and some others have given only slight reaction. The grasses, both weedy and useful species, have been almost immune to the chemicals.

The cost of 2,4-D, including the materials necessary to bring it into solution, is about $6.00 an acre. So far as we know, it is harmless to animal life, and is not corrosive, inflammable, or otherwise dangerous.

There thus appears to have been introduced into the weed picture a new chemical weed killer of tremendous potentialities. Already some rather sensational stories about it have appeared in the press, and several periodicals, including the Country Gentleman, are preparing feature articles about it. In this situation, it behooves all weed people to inform themselves about the process. Next year, no doubt, tests by the hundred will be undertaken all over the United States, and some disinterested agency will be needed to assemble the results of these tests and correlate them. If I may be permitted to say so, the logical group to do this for this area is the Research Committee of this Conference.

Mr. Zahnley: We will now hear from a railroad man, Mr. A. K. Hepperly, who is the Agricultural Agent for the C. B. & Q Railroad. He will discuss the weed problem on non-agricultural lands.

WEED ERADICATION PROBLEMS ON NON-AGRICULTURAL LANDS

Mr. A. K. Hepperly
Agricultural Agent
C. B. & Q. Railroad

Nearly 15 years of observations of noxious weed control work in states, both east and west of the Missouri River, have been convincing that results similar to those received on fields which are farmed cannot be expected on non-agricultural lands. This leaves the highways, irrigation ditch companies, cemeteries, golf courses, parks, city property owners, and railroads with a different problem from the farmers when it comes to eradicating noxious weeds. It is these problems, together with experiences with various methods and materials we have used during the past 15 years that I wish to discuss with you briefly this morning.

Most of you men assembled here have given long years of hard work and many many hours of thought to ways and means of killing weeds. Primarily your efforts have been directed toward the use of chemicals and cultivation methods on land that had previously been farmed or which went into cultivation when your weed killing experiments were completed. We acknowledge this was the logical place to do your research work because it is the farm areas that must be kept productive. You are all closely enough associated with the broad field of agriculture to know that the wealth of the Nation lies in the productiveness of our soils. You also recognize that noxious weeds are a threat to our national welfare because of their present and possible greater future adverse effect on our farm income. We railroad people also realize that weeds now greatly reduce production of the various crops, and that unless weeds such as bindweed, Canada thistle, Russian knapweed, hoary cress, and others are brought under control that these weeds could make many large areas unprofitable to farm. As the railroad income is directly related to the farm income, we are naturally interested in seeing farm income at the highest possible level. Had I time I would like to show you how closely railroad operating revenue fluctuates with farm income, but I do not have time so you will need to take my word for it that prosperity on the railroad depends on prosperity on the farm. We have more at stake than individual farmers so are naturally interested in seeing the great weed menace brought under control. If at times any of you may have felt the railroads were not enthusiastic enough about getting rid of weeds on their rights of way, it is due to the absence of practical eradication methods rather than not recognizing the economi need of weed control.

As a result of the vast amount of experimental work you have conducted, practical methods of controlling weeds by cultivation or by a combination of cultivation, chemicals, and smother crops have been devised. Unfortunately physical reasons usually prevent the cultivation of non-agricultural lands so we must look to other methods of control. If I had my way the Burlington Railroad would move the line fence over to the bottom of the grade thus making it possible to cultivate the farm about two-thirds of our 100 ft. right of way, but other departments of the railroad have good reasons for keeping the fences on the right of way line.

From a scientific point of view possibly sodium chlorate should kill noxious weeds as well on railroad rights of way as it does on your experimental plots, but our experience indicates such is not the case. I have no explanation for this but fully believe you research workers will find the answer if you do not already know. I know some believe comparable results are not obtained because of the high humus content in the virgin soil, others think it may be due to the acid condition of cinders which comprise part of the road bed at many places, and still others think it may be due to the rapid penetration when chlorate is used on crushed rock or coarse gravel ballast. These are only surmises, but I do know that if sodium chlorate is going to be the product you continue to recommend for use on non-agricultural land that you men must find the real reasons for the erratic results and find a way of obtaining more dependable kills. Even when the original stand of weed may be successfully killed with chlorate the seedlings in a few years start another infestation. I do not infer that the railroads have not killed noxious weeds with chlorate because they have, but I want to point out the results are so erratic that it requires so much labor for the original application and the follow-up treatments, and that the seedling problem, together with the fire hazard of sodium chlorate makes it fall far short of a solution to the railroads' problem of weed eradication.

After receiving good results from borax in our territory east of the Missouri River and fair results on experimental plots west of the Missouri River, considerable borax was used here in Nebraska in the fall of 1942. Inspection during the summer of 1943 showed good kills at most locations some of which were 100 per cent. Greatly encouraged, borax was used on a much larger scale in the fall of 1943. Inspection in 1944 showed borax can be as erratic as sodium chlorate. A total of nearly 700 square rods or approximately 45 acres were treated at the rate of 15 pounds per square rod at a total of 321 different locations in the three states of Nebraska, Wyoming, and Montana. Most of it was applied to bindweed, although some was put on salt grass and some on perennial peppergrass. A recap of the reports submitted by Roadmasters, who supervised the applications showed that at 12 per cent of the locations no kill was obtained, 3 per cent showed from 1 per cent to 24 per cent kill, 10 per cent showed from 25 per cent to 49 per cent, 33 per cent showed from 50 per cent to 74 per cent kill, 28 per cent showed from 75 per cent to 90 per cent kill, and 9 per cent showed from 90 per cent to 100 per cent kill.

Several significant things were apparent from the reports. One was that the best kills were obtained where rain was received after the borax was applied, another that here at Omaha where good kills were obtained from the 1942 applications practically no bindweed was killed from the 1943 applications. To me the most significant thing was that where chlorate or salt had previously been applied the borax gave the only 100 per cent kills reported. Out of 11 of these locations 8 gave 100 per cent kill, and the other 3 were in the 90 per cent to 100 per cent kill classification. Most of you have used mixtures of borax and chlorate with varying degrees of success, but I know of no research work where borax was used as a follow-up treatment when chlorate gave only a partial kill. When out of 321 different locations the only 8 that gave 100 per cent kills were where chlorate or salt had previously been applied, I would want to investigate further.

You may wonder how it happened that borax was applied to areas previously treated with salt and chlorate. A brief review of the circumstances will reveal this, and also serve to show the problem we are faced with in dealing with non-agricultural lands. These locations are in Township F, Seward County, where the people in Nebraska know was one of the first organized weed districts in the state.

Chlorate was first applied in this area by our section crew in 1934. Practically no kill was obtained and we blamed the dry weather for it, although we saw the possibility of uneven distribution because of inexperienced labor, so in the fall of 1935 we hired an experienced farmer to apply the chlorate. Partial kills were obtained and in the fall of 1936 the experienced farmer again applied chlorate as a follow-up treatment. Where the original stands were not killed out salt was applied in 1939 and 1940. By 1943 established plants were again present in the areas treated with salt or sodium chlorate so they received an application of borax in November 1943. This application apparently did the job, but I am making no comments as to how long the job will stay done simply because I do not know and I do not believe anyone else knows what to expect.

Salt offers a possibility for some non-agricultural land, particularly railroads. It cannot, however, be used in cemeteries, on lawns, in parks and around trees and shrubbery. Generally good kills have been obtained with 1 pound per square foot applications and the seedlings have not become established as quickly on salted areas as on land treated with chlorate. It is not, however, 100 per cent sure, and the cost of both material and labor to apply it is very high. Salt is also objectionable because it frequently causes a soft track when used on the grade, and for this reason most of the roads will not use it on the grades and some roads refuse to use it on any part of their rights of way. Until the last two years I felt salt, despite its high cost, was the answer to most of the weed problems on railroad property. This past summer, however, inspection showed areas treated as recently as four years ago have established bindweed plants in them, and Hanson's plots at Lincoln on railroad property where almost 100 per cent kill was received from salt applications in the fall of 1942, now have quite a number of bindweed plants growing in them. Here at Omaha I can show you a plot that received 500 pounds of salt in November 1940, which now has several well established bindweed plants growing in it. An adjacent plot which received 273 pounds or the recommended amount of 1 pound per square foot, has many plants growing in it. The 500 pound application per square rod came about from a Section Foreman's idea that 1 pound per square foot was not sufficient to kill bindweed. Accordingly when a series of observation plots were being laid out an extra plot was included and the Section Foreman kept piling on salt until there was enough on it to suit him, and it happened to be almost exactly 500 pounds. Both plots were free of bindweed until last year. In this connection it is of interest to know that both plots raised a good crop of kochia the first year after the salt application, and have continued to do so since. This is considerably different from the plot at Hays, Kansas Experiment fields where a plot received salt in 1919 and has been barren of vegetation since that time, but lends itself to a previous statement that results on railroad rights of way are not consistent with results obtained in the various weed experimental farms. It was this same Section Foreman who last year, when laying out rates of application of borax test plots, conceived the idea of using soda ash. This material was on hand as it is used as a water softener at a plant near where the plots were laid out. His records are not too dependable but when Bill Klatt, Noel Hanson, J. A. Hyland, and I inspected the plots this summer, the one plot on which it was very evident the bindweed had been killed was the one according to the Section Foreman that received the soda ash. Hanson used it on some plots this fall and if similar results are obtained we may be off to a new start on a better weed killer than any of us know today.

In addition to the chlorate, borax, and salt, the railroads use sodium arsenite principally as a spray for annual weeds, but it is also found to be effective on bindweed when used in heavy amounts or at frequent intervals. Noel Hanson has shown

that four or five applications per season at the regular rate will kill out stands of bindweed and has also shown that heavy applications of two or three gallons per square rod will completely sterilize the ground. Such heavy applications are very expensive, but it may be the best way out, particularly around lumber storage piles and buildings where railroads annually spend large sums scalping to keep vegetative growth down to eliminate fire hazards.

It may be also that sodium arsenite is effective in combination with borax as it has been observed that better kills were obtained where borax was used on the grade that had received a spray of sodium arsenite for a number of years than in the same patch of bindweed off the grade. I am not suggesting that this is a fact, but I can see the possibility that if as much work had been done with borax in conjunction with sodium arsenite, and other possible materials as has been done with chlorate, that a better weed killing agent for non-agricultural land might be known today. I am not saying this critically of the work which has been done as I recognize your big job was to find control methods for cultivated lands. This you have successfully done, but if the big job of eradicating weeds is to be successful, the non-agricultural lands must be cleaned up as well as the farm land. I believe you will all agree that you have not made the progress on non-agricultural land that you would like to have made. I know you can make good reports of the large amounts of chlorate and other chemicals being used, but when you see the weeds coming back in the areas that have been treated 2, 3, or 4 times, I do not believe you conscientiously feel you are really getting the job done. Our experience and the work, except in Nebraska, done by the trained county crews has been this: We have chlorated and salted in Kansas, salted and boraxed in Nebraska, cultivated and Atlacided in Montana, seared and electrocuted in Wyoming, and we still have plenty of bindweed to try any new things any of you have to offer.

If the vast amount of noxious weeds growing on non-agricultural lands is to be eradicated, it is my thought that a more effective weed killing agent must be found. Possibly we may never reach the goal of complete eradication, but must be satisfied with control measures. Instead of thinking in terms of eradication, possibly we should give more thought to a control program that may consist of establishing barriers around non-agricultural lands to keep the weeds isolated. It is hard to visualize how many of the weeds growing on non-agricultural lands will ever be eradicated. Within 10 minutes time from this hotel I can show you acre after acre of bindweed growing on banks that are almost perpendicular, on drainage ditches, on land that apparently belongs to no one, and in cracks in sidewalks. The Nebraska State Capitol, one of the finest buildings in the world, is surrounded by a beautiful lawn, but infested with bindweed, and on the Nebraska Agricultural College campus an experiment farm bindweed is still to be found despite a vigorous effort to eradicate it over a long period of years. These conditions are not peculiar to Nebraska alone, but similar examples exist in most other states as well. To me it is evidence that you do not have an effective, practical method to offer those who must deal with noxious weeds on non-plow land.

I may sound unduly pessimistic, but I assure you I do not talk this way to a group of farmers. To them weed killing is a job that can and must be done. To you research workers and you state weed officials I point out the problems in the hope that research work will find the answer to them. There is more to do than has been done.

The points I want to leave with you are that the eradication of noxious weeds on non-agricultural land such as cemeteries, parks, highways, city property, along

irrigation and drainage ditches, on creek and river banks, and on railroad rights of way is a different problem from the methods you have successfully developed for agricultural land, and that the problem of eradicating noxious weeds on non-agricultural land at present is far from solved.

I see no reason, however, why the problems cannot be mastered. In this room today are the best weed minds of the north central states, yes, of the entire United States as Mr. Kephart of the United States Department of Agriculture, and Walter Ball of California and others are present. Surely this group collectively can develop as effective a weed control program for the non-agricultural lands as you have done for the farm land. The welfare of our Nation's agriculture depends on it. It is a challenge to all of you to find ways and means of getting the job done.

Mr. Zahnley: Thank you Mr. Hepperly. I am sure we all understand your problems much better. We will now hear from Mr. F. L. Timmons of the Bureau of Plant Industry, Soils, and Agricultural Engineering from Hays, Kansas on "Cultivation and Cropping Methods in Kansas".

CULTIVATION AND CROPPING METHODS IN KANSAS

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The experimental results presented in this discussion were obtained, for the most part, at Hays, Kansas, 1/ which is located in the eastern edge of the territory in which dry-land methods of farming are the most successful. The 76-year average annual rainfall at Hays is 22.7 inches, while the average for the period of years covered by the experiments reported here was 21.8 inches.

The roots of field bindweed penetrate very little more than 5 or 6 feet into the soil on upland at Hays. Most of the results reported here were obtained on upland, working with relatively shallow-rooted bindweed. It has been interesting to observe how closely our results at Hays have agreed in many respects with those obtained with much deeper rooted bindweed at stations in more humid areas, and how well the methods proved successful at Hays have worked in actual practice in eastern Kansas, as well as in western Kansas.

As a guide to the discussion, a series of mimeographed tables, summarizing our experimental results with cultivation and cropping methods on field bindweed and other perennial weeds, has been prepared. Table No. 1 shows the effect of bindweed on the yield of nine different crops under average farm methods of culture during the period 1936 to 1944. It will be noted that the average yields of the four small grain crops on bindweed-infested land ranged from 63 to 73 per cent of those on noninfested land, with wheat showing the greatest reduction and rye the least. The grain yields of corn, kafir, and milo were only 25 to 35 per cent as much on infested land as on clean land. The forage yields of corn, kafir, milo, sorgo, and

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1/ Operated as a cooperative project at the Fort Hays Branch Experiment Station by the Kansas Agricultural Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering.

Sudan grass on infested land ranged from 45 to 58 per cent of the yields on non-infested land. In general, bindweed reduced the yields of summer-growing crops more than the small-grain crops and was more detrimental to all crops in dry years than in wet years.

Table 1. The effect of bindweed on the yields of crops under average farm methods of culture at Hays, 1936 to 1944.

Crop	Grain yields (Av. of 9 yrs.) Bushels per acre Infested	Nonin-fested	Per cent of Non-infested	Forage yields (Av. of 9 yrs.) Tons per acre Infested	Nonin-fested	Per cent of non-infested
Wheat	9.5	15.0	63			
Rye	12.6	17.3	73			
Barley	16.7	25.8	65			
Oats	20.6	32.3	64			
Corn	2.3	7.6	30	.62	1.34	46
Kafir	5.8	16.5	35	1.51	3.28	45
Milo	3.5	14.0	25	1.18	2.20	54
Sorgo				1.94	3.33	58
Sudan grass				.98	2.01	49

A summary of experimental results on the frequency of cultivating bindweed is presented in Table No. 2. Seven different intervals were tested, ranging from cultivation at each first emergence of bindweed to 28 days after emergence. As an average of 10 completed experiments, the most efficient was 12 days after emergence. This treatment eradicated the bindweed with 16.5 cultivations, as compared with 19.2 for cultivating 8 days after emergence, 23.3 for 4 days after emergence, and 33.2 for cultivation at each first emergence. These correspond to intervals of about 22, 18, 13, and 9 days between successive cultivations. Cultivating 16 days after emergence also accomplished eradication with an average of 16.5 cultivations but frequently required 3 years to eliminate the bindweed; whereas, the more frequent cultivations nearly always eliminated bindweed in 2 years. Cutlivation 20 days after each emergence eventually eradicated bindweed in 3 to 5 years but required an average of more than 19 operations. Cultivation 28 days after emergence eradicated bindweed in a few cases in 4 or more years but in other cases has failed to do so in experiments continued 7 years.

Table 2. Summary of results in frequency of cultivating bindweed experiments started 1935 to 1942 at Hays

Cultivation interval (days) After each emergence	Between Cultivations (average)	Cultivations necessary to eradicate bindweed Av. of 10 Expts. 1935 to 1942	Range in different Expts.	Years Necessary for eradication
0	9.1	33.2	23 to 55	2
4	13.2	23.3	17 to 37	2
8	18.0	19.2	13 to 30	2
12	21.8	16.5	11 to 23	2
16	25.8	16.5	10 to 26	2 or 3
20	29.2	19.1 *	13 to 26 *	3 to 5
28	37.8	22.8 **	15 to 36 **	4 to 7 **

* Eradication not complete in the 1941 or 1942 experiments.
** Eradication not complete on both duplicate plots in any of the experiments.

The column in Table No. 2 showing the total number of days between cultivations for each frequency represents the average for the first year in each experiment. During the spring and summer when bindweed was growing rapidly and emerging quickly the interval was 3 or 4 days less than the average for the season.

The results of these experiments are in accord with the results of extensive studies of food reserves in bindweed roots conducted from 1936 to 1940 at several points in the Central States Region. In these studies, it was found that the root reserves decrease during 12 to 16 days after emergence following cultivation, after which they begin to increase rapidly.

As shown in Table No. 3 there has been very little practical difference in the effectiveness of bindweed cultivation treatment started at different times during the season. Averages of from about 16 to about 18 cultivations were necessary for eradication. In farm practice, there is advantage in beginning cultivation immediately after small-grain harvest or as early as possible in July. When this has been done it has been possible in about 50 per cent of the cases to eliminate bindweed with the first one and one-half seasons of cultivation with the loss of only one crop.

Table 3. Summary of results of date of beginning experiments with bindweed conducted at Hays, 1936 to 1944.

Approximate date of beginning cultivation the first year	Total cultivations required for eradication	
	Av. of 4 experiments started 1936-39	Av. of 7 experiments started 1936-42
First emergence in spring	18.1	
May 1	17.4	17.1
June 1	15.9	
July 1 (after harvest)	17.6	17.6
Aug. 1	16.3	
Sept. 1	16.1	15.9

Results in three depth-of-cultivation experiments on bindweed at Hays are given in Table No. 4. Deep plowing to depths of 8 or 12 inches as the original operation followed by shallow 4-inch cultivations reduced the number of operations necessary for eradication only one or two and caused considerable difficulty with later shallow cultivations. Repeated deep-plowing at depths of 8 or 12 inches accomplished eradication with from 5 to 6 fewer operations than 4-inch cultivation. However, the time required for the elimination of bindweed was only slightly less and the total cost of the deep-plowing was much greater than that of the more numerous shallow cultivations. Another disadvantage of deep-plowing is shown by the fact that the number of viable bindweed seeds left in the soil at the close of the experiment was considerably greater on the deeply plowed plots and more of the seed was buried deeply in the soil, where it would remain viable and be an ever-present hazard to re-infestation of the land over a much longer period of years.

Shallow hoeing has proved very effective in eradicating bindweed at Hays. Three experiments have been conducted to establish the best frequency. As may be seen in Table No. 5, the most economical interval between cultivations has been 14 days (2 weeks). Hoeing every 21 days (3 weeks) eliminated the bindweed in two of the experiments but is not working out so well in the third experiment started in 1943.

Table 4. Results obtained in depth of cultivation experiments on bindweed at Hays. Bindweed cultivated 10 days after each first emergence on all plots.

Depth of cultivation (Inches)		Cultivations necessary for eradication Experiments started				Av. cultv. interval during 1st. yr. of each experiment
Original	Subsequent	1937	1938	1942	Average	
						(days)
4	4	18.5	23.5	24	22	18.6
8	4	18.5	21.5	22	21	19.2
12	4	18.5	21	20.5	20	19.5
8	8	16	19.5	16	17	21.2
12	12	13	17	17	16	23.2

Table 5. Results from frequency of hoeing bindweed experiments at Hays.

Interval between hoeings (days) Hood shallow (1")	Total hoeings required to eradicate bindweed Experiments started			Surviving plants per sq. rod Oct. 1944	
	1941	1942	1943	1942 Expts.	1943 Expts.
7	40	35	42 *	0	11
10	29	--	--	--	--
14	21	21	23 *	0	60
18	--	23	19 *	0	82
21	16.5	22	16 *	0	657
28	--	18 *	12 *	150	920

* Eradication not complete. More hoeings necessary.

The results of hoeing experiments with dogbane and Russian knapweed are shown in Table 6. Both dogbane and knapweed required nearly 50 per cent more hoeing operations and a year longer to accomplish eradication than did bindweed. Hoeing every 4 weeks was about as effective and much more economical in the case of both weeds, but every 3 weeks is probably the best interval. Apparently, less frequent hoeing or cultivation is necessary for either of these weeds than for bindweed. The 6 week hoeing interval which was included in the first two experiments caused very little reduction in the stand during the first 2 years and was abandoned. However, the 3 week interval begun on these plots at that time completed the eradication quickly, indicating that the weeds had been greatly weakened by hoeing every 6 weeks. Spading 12 inches deep every 4 weeks eradicated both dogbane and knapweed more quickly and with about six fewer operations than shallow hoeing every 4 weeks. In experiments conducted cooperatively with the State Weed Supervisor, Mr. T. F. Yost, in southern Kansas, Johnson grass was eradicated usually in one season, with 6 to 10 cultivations at intervals of 2 to 3 weeks. Cultivation every 4 weeks required longer for eradication and cultivation every 6 weeks was unsatisfactory.

The implement used in these hoeing experiments is a home-made wheel hoe with a 16 inch blade. With it, it is possible to hoe more cleanly and five times as rapidly as with an ordinary hand hoe. Mr. T. F. Yost has published a circular showing detailed plans for this wheel hoe and would probably be glad to make copies available to any who are interested.

Table 6. Results from frequency of hoeing dogbane and Russian knapweed. Experiments started in 1940 and 1942.

Interval between hoeings (weeks)	Hoeings required for eradication			Plants surviving per sq. rod - Oct. 1944
	Dogbane	Knapweed		Knapweed (1942 Expt.)
	1940	1940	1942	
2	31	31	26	0
3	--	22	23	0
4	17	21	21 *	34
6 * (1940 & 1941) 1-3 (1942)	16	14	--	--
4 (spaded 12")	11	15	14	0

* Hoeing every 6 weeks in 1940 and 1941 did not noticeably reduce the stand of dogbane or knapweed but apparently had weakened both.

The most economical and generally satisfactory methods of eradicating bindweed that have been developed at Hays are those which use clean cultivation in various combinations with competitive crops. The results of six experiments using wheat as the competitive crop in nine different methods are summarized in Table No. 7. Rye was compared with wheat in some of the methods but the results are not included in the table. In general, it was slightly more effective than wheat. The methods are listed in Table No. 7 in order of the intensiveness of the cultivation treatment. The methods range in intensiveness from 2 years of clean fallow before the first crop is planted in No. 1 to continuous wheat with only two cultivations between harvest and seeding in the check method No. 9. A new experiment of this type has been started at Hays each year since 1936 and in most cases each experiment is continued 6 years. Only the first 6 experiments started previous to 1942 have progressed sufficiently to permit summarization of the results.

Bindweed was usually eradicated in 2 years by methods No. 1 and No. 2, while from 2 to 4 years were required in methods Nos. 3, 4, and 5, and 2 to 5 years were necessary in methods 6 and 7. Method No. 2, which uses a sorghum-smother crop the first year, proved to be the least expensive of all the methods tested and was much more satisfactory than method No. 1 from the standpoint of erosion control. Methods 3 to 5, inclusive, which used 1, 2, or 3 wheat crops in rotation after the first year of fallow were also better than No. 1 for preventing erosion, although they required longer period of time and more cultivations to eliminate the bindweed. Method No. 8, which involved continuous cropping with intensive cultivation between harvest and seeding of each crop, eventually eliminated bindweed in 4 to 6 years but required several more cultivations than the methods which used one or more years of fallow. The total number of cultivations necessary for eradication of bindweed and for seedbed preparation for crops after the elimination of bindweed was approximately the same for all 8 of the eradication methods except No. 2 in which the average number was about 4 less. The average yields of crops were greatest in methods 4 and 6. The best measures of the economy of the different methods are the total number of cultivations used during the experiment and the average yields of wheat produced. Judged by these standards, methods 4 and 6 were the most economical for the region of Hays.

Table 7. Small grain competitive cropping systems. Summary of data from experiments started in 1936 to 1941, Hays.

Method No.	Method and Crop	Years required to eradicate bindweed	No. of cultivations To eradicate bindweed	No. of cultivations Total used during the expt.	Av. Grain yield bu. per acre
	(Av. of 6 expts. begun 1936-1941) 1/				
1	Fallow 2 yrs; wheat each year thereafter seeded Oct. 5 to 10	2.1	17.8	28.1	12.4
2	Cult. May 1-July 1; drill sorgo; fallow 2nd yr; seed wheat Oct. 5 to 10 yearly thereafter.	2.0	15.3	24.6	11.9 2/
3	Alternate fallow and wheat, seeded Oct. 5 to 10 until eradication complete, then wheat every year	2.6	20.4	29.2	12.9
4	Fallow 1 yr; wheat 2 yrs, seeded Oct. 5 to 10 repeat rotation.	2.8	19.7	29.2	14.4
5	Fallow 1 yr; wheat thereafter seeded Sept. 20 to 25 and cut for hay; except allowed to mature grain after the bindweed eradicated.	2.5	19.2	27.8	1.9 tons 3/
6	Fallow 1 yr; wheat 3 yrs, seeded Oct. 5 to 10; repeat rotation.	3.2	21.8	28.2	14.5
7	Fallow 1 yr; wheat 3 yrs, seeded Sept. 20 to 25; repeat rotation.	3.6	22.1	27.6	13.1
8	Wheat every year seeded Oct. 5 to 10; intensive cultivation between harvest and seeding.	4.3 *	25.8 *	27.9	13.3
9	Wheat every year, seeded Sept. 20 to 25. Plowed Aug. 1, cultivated Sept. 1 to 10 each year.	5.1 **	11.8 **	11.8	10.8

1/ A new experiment was started each year from 1936 to 1941 and each experiment was continued 4 to 6 years. Experiments started in 1940 and 1941 are not complete.

2/ In addition to the wheat crops, a crop of sorgo hay was produced in the first year of each experiment. The average yield of cured sorgho hay for all experiments was 1.4 tons per acre.

3/ Hay yields were taken during the first 3 years in each experiment. Grain yields in subsequent years averaged 16.1 bushels per acre.

* Eradication not complete at close of experiment or at seeding time in 1944 in two of the experiments.

** Eradication not complete at the close of the experiment or at seeding time in 1944 in any of the six experiments.

Late seeding of wheat on bindweed-infested land gave slightly better results than early seeding as may be seen by comparing methods 6 and 7.

With the check method No. 9 there were less than half as many cultivations as with the more intensive eradication methods but the stand of bindweed was not materially reduced and only 75 per cent as much wheat was produced as by the better methods.

The results in six completed experiments with annual summer-growing smother crops at Hays are summarized in Table No. 8. Sorgo, Sudan grass, and millet were compared with two methods and sorgo was tested with two additional methods. Method No. 2 in which the crops were grown every year with early season periods of intensive cultivation required longer to eradicate bindweed but about the same number of cultivations as method No. 1 in which the land was fallowed a full year before the first crops were seeded. Method No. 2 proved to be the most economical with each of the three crops since the total number of cultivations used during the experiment was less and the average yields of forage were slightly higher.

Sorgo and Sudan grass were about equally effective in both methods and both eradicated bindweed quicker and with fewer cultivations than did millet. Sudan grass produced only 65 per cent as much forage as sorgo and millet produced less than half as much as sorgo in either method. Sorgo with method No. 2 eradicated bindweed on bottomland more quickly, with fewer cultivations and produced over twice as much forage as on upland. This suggests that this method would be more effective in more humid areas than it has been at Hays.

Method No. 3 in which the cultivation treatment is started after barley harvest the first year has consistently proved less satisfactory than methods 1 or 2. No explanation can be given for this. The check method No. 4, which is comparable to average indifferent farm practice in the Hays area, has produced much lower forage yields and has never accomplished eradication or even much reduction in the stand of bindweed in experiments that have been continued as long as 7 years.

An experiment with four different lawn grasses closely clipped every 2 weeks in competition with bindweed has been underway 2 years. Some of the better methods have reduced the stand of bindweed 90 to 99 per cent and give promise of completely eliminating it.

Since 1937, an experiment has been conducted comparing different cropping systems for the control of bindweed seedlings. The seriousness of the bindweed seedling problem was demonstrated 5 years ago when examination of a field from which bindweed had been eradicated 20 years before showed an average emergence of six seedlings per square rod. Since then bindweed seedlings have been discovered in this field in considerable numbers every year. An encouraging feature in this instance is that the good practical methods of farming in use in this field have prevented the re-infestation of the land over a period of 25 years. In another area on the experimental project, indifferent methods of farming were purposely used on land from which bindweed had been eradicated and the land was completely re-infested from seedlings in 1 year.

Table 8. Annual summer-growing smother crops. Summary of data from experiments started 1936 to 1941, Hays.

Method	Crop (closely-drilled)	Cultivation Method	No. of cultivations: Yrs. to eradicate bindweed	No. of cultivations: To eradicate bindweed	No. of cultivations: Total during expt.	Av. forage yield T. per A.
			(Av. 6 expts. begun 1936 to 1941) 1/			
1a	Sorgo	Fallowed one year, then cultivated each yr. thereafter from about May 10 to July 1 and the crop drilled	2.3	16.7	21.3	2.43
1b	Sudan grass		2.2	16.6	21.2	1.59
1c	Millet		3.2	21.2	23.0	1.11
2a	Sorgo	Cultivated from about May 1 to July 1 and the crop seeded each year	3.2	16.8	18.9	2.48
2a 2/	Sorgo		2.8	14.2	19	5.64
2b	Sudan grass		3.0 *	15.9 *	18.3	1.66
2c	Millet		3.4 *	21.9 *	22.8	1.22
3	Sorgo	Cultivated after barley harvest the 1st yr. and from about May 10 to July 1 and sorgo seeded each year thereafter	3.4 *	18.9 *	20.2	2.17 3/
4	Sorgo	Plowed, harrowed and drilled June 1 each year	4.0 **	5.6 **	5.6	1.45

1/ A new experiment was started each year from 1936 to 1941 and each experiment was continued three or four years. The experiment started in 1941 is not complete.

2/ This plot is located on bottomland. The data are included here as a bottomland comparison with the results on upland under the same method (2a).

3/ A crop of barley grown the first year in each experiment is not included in this average.

* Eradication not complete in one experiment at the end of the experiment.

** Eradication not complete in any of the six experiments at the end of the experiment.

Wheat grown continuously, or in rotation with fallow, has prevented re-infestation of the land from seelings over a period of 7 years. Drilled sorgo or Sudan grass has also been effective. On the other hand, intertilled sorghum has permitted bindweed seedlings to become established and re-infest the land even with intensive methods. In general, it appears that any close-drilled small grain or forage crop will effectively control bindweed seedlings where a good stand of crops is obtained and the land is cultivated at least once a month between harvesting and seeding of the crops. The practices that have nearly always permitted bindweed seedlings to become established on previously infested land are continuous or frequent growing of a row crop, allowing small grain stubble to lie idle without tillage after harvest, or allowing more than 6 weeks between tillage operations at any time during the growing season when the land is not in a close-drilled crop.

Table No. 9 summarizes the results from a practical research project that was conducted cooperatively with the State Weed Supervisor, Mr. T. F. Yost, and his assistants and county weed supervisors. This table is a condensed summary prepared from 856 records of cultivation to eradicate bindweed on farms throughout Kansas during 1938 to 1942. Space will not permit a detailed discussion of the results but the main conclusions may be briefly stated.

The number of cultivations required to kill bindweed dropped sharply as the interval between cultivations increased. In other words, bindweed was killed with less work by those who waited longer between cultivations. On the other hand, the land was out of crop longer. Considering both factors, it is probable that an average interval of about 16 days between cultivations was the most economical practice.

Beginning cultivation after small grain harvest (B) required about two more operations to kill bindweed than cultivation started in the spring (A) but the land had to be left out of crop a second year only 50 per cent as often. Planting a sorghum smother crop (C) about July 1 of the second year of cultivation made it possible to eradicate bindweed with 5 to 7 fewer operations and the loss of a second crop was necessary in only 10 per cent of the cases.

More cultivations were necessary to kill bindweed in central Kansas than in other sections. Fewer cultivations were necessary in north central Kansas when done by the farmers themselves and in other sections of Kansas when done by county outfits. The differences are small in all cases.

Bindweed averaged slightly more difficult to eradicate on upland than on bottom land and tended to be more difficult to kill on heavier soils than on lighter soils. Bindweed patches of 0.5 acre or less were definitely easier to eradicate than larger areas, but patches of 0.6 to 1 acre required about as many cultivations and as long a time as areas of 1 to 5 acres or more.

The moldboard plow and straight blade machines both eradicate bindweed with slightly fewer cultivations than the duckfoot cultivator, the implement most commonly used by farmers. The oneway was about as effective as the duckfoot, but the disc harrow required three or more additional cultivations on the average, than did other implements.

Table 9. Summary comparisons from records of cultivation on farms in Kansas during 1938 to 1942.

	Number of Records	Number of cultivations (Average)	Per cent of cases in which land out of crop 2 years	Days between cultivations (Average)
1. Relation of frequency of cultivation to number of operations required for eradication and number of crops lost.				
	105	24.0	80	13.2
	213	19.7	80	15.8
	242	18.8	90	17.5
	140	18.0	90	19.1
	146	17.2	110	21.7
2. Effect of time of beginning cultivation and use of a smother crop on cost of eradicating bindweed.				
a. Cultivation started in spring and continued until bindweed dead	708	18.4	100	--
b. Cultivation started after harvest and continued until bindweed dead	85	21.3	50	--
c. Cultivation started either time but land drilled to sorghum smother crop about July 1 of 2nd year	53	15.6	10	--
3. The relative difficulty in eradicating bindweed by cultivation in different sections of Kansas.				
a. Cultivation done by farmers themselves.				
Northeastern	73	19.0	100	18.5
Southeastern	46	18.9	70	17.4
North central	161	19.0	80	17.4
South central	148	20.9	90	16.8
Northwestern	71	16.2	80	19.2
Southwestern	37	17.5	120	18.8
State	536	19.1	90	17.8
b. Cultivation work done by county owned equipment.				
Northeastern	43	19.1	70	16.9
Southeastern	44	16.5	80	18.0
North central	104	23.3	90	15.3
South central	101	19.9	90	16.9
Southwestern	18	17.3	120	22.5
State	310	19.8	90	17.5

Table 9. (Continued)

	Number of Records	Number of cultivations (Average)	Per cent of cases in which land out of crop 2 years	Days between cultivations (Average)
4. The relation of type of land to bindweed control by cultivation.				
Upland	742	19.4	90	--
Bottomland	105	19.0	80	--
5. The relation of soil texture to bindweed control by cultivation.				
Light (sandy)	159	18.8	90	--
Medium (silt)	505	19.3	90	--
Heavy (clay or silty clay)	181	19.8	80	--
6. Relation of size of bindweed patch to the difficulty of eradication by cultivation.				
0.5 acre or less	50	16.4	60	--
0.6 to 1 acre	118	19.2	90	--
1.1 to 5 acres	323	19.9	90	--
Over 5 acres	311	19.6	90	--
7. A comparison of different cultivation implements in the eradication of bindweed. (Not including county work)				
Duckfoot	329	19.4	90	--
Straight Blade	118	18.0	90	--
Moldboard	55	17.7	90	--
Oneway	20	19.7	80	--
Disc harrow	15	22.7	80	--

This study of the factors affecting the eradication of bindweed by cultivation and cropping methods under practical farm conditions was made possible by close cooperation between the action and research agencies in Kansas. It is a good example of the value and advantages of such cooperation. In so far as comparisons are possible these results agree remarkably well with those secured in the experiments at Hays.

Mr. Zahnley: Thank you Mr. Timmons. We will now hear from Dr. A. L. Bakke of the Department of Botany, Iowa State College on "Competitive Cropping".

COMPETITIVE CROPPING

Dr. A. L. Bakke
Research Professor Botany and Plant Pathology
Iowa State College

Competition - Act of seeking or endeavoring to gain what another is endeavoring to gain at the same time; common strife for the same object. Our dictionaries fail to mention competition as it occurs in plant life. The first definite though necessarily general characterization appears to have been given by De Condolle in 1820. He stated that all the species of a region, all the plants of a given place, are in a state of war with one another. The first to establish themselves in any spot tend by the mere fact of occupation to exclude other species from it; the taller suppresses the shorter, the more resistant replace those with a short span of life, the more fecund take possession of the space that might be occupied by those of less vigor. According to Weaver and Clements, "When a plant is carried into a group of other plants or is surrounded by its growing offspring, the struggle which results between the individuals is competition. The struggle for existence in the plant world is between each plant and its habitat, the latter being changed by competition in consequence of the demands made upon it by other plants."

The chief environmental factors in plant competition are water, light, and mineral nutrients. Two plants do not compete if water, light, and mineral nutrients are in excess of the needs of both. Competition begins when the supply of any one of these falls below the requirements of both. The moment that the roots of one enters the area from which the other draws its water supply, or the foliage of one begins to overshade the leaves of the former the reactions of the former modify unfavorably the factors controlling the latter and competition is at once initiated.

The same relation exists throughout the process. The taller, stronger, the more branched, or the better rooted plant reacts upon the habitat and the latter immediately exerts an unfavorable effect upon the weaker, shorter, less branched, or more poorly rooted plant. An increase in the leaf surface of a plant not merely reduces the amount of light and heat available for these near it or beneath it but it renders necessary the absorption of more water and nutrients, and still further decreases the amount present. The inevitable result is that the successful individual prospers more and more and the less successful one loses ground in the same degree. As a consequence the latter disappears entirely or is handicapped to such an extent that it fails to produce seeds or these are reduced in number and vitality. The distance between plants affects directly the degree of competition. Competition increases as the interval diminishes and the reverse.

Competition in field and garden crops differs somewhat from that found in natural communities. The habitat is controlled in as large a degree as possible in favor of the crop. This means not merely maintaining the water content as nearly as possible at an optimum by tillage, irrigation, or drainage but also the nutrient content by rotation or fertilization. In spite of cultivation, weeds do appear. In our more favorable agricultural areas, the moisture and much of the fertilization are left to take care of themselves. Light then becomes the outstanding factor, Light is the direct source of energy for the manufacture of food. The primary response of plants to light is the production of chlorophyll.

In excavations 4 x 4 feet made at different times between the years 1933 and 1937 at Hawarden and Cherokee, Iowa to determine the extent of the root system of the European bindweed, no outgrowth of serial shoots was observed below a depth of approximately 12 feet. The light intensity at that depth as measured by a Weston Light Meter on September 19, 1937 at 2 p.m. was 42 foot candles or 0.56 per cent of full sunlight. As there was a gradual increase in the number of shoots above the 12 foot mark, it was evident that all the factors necessary for the development of green shoots had not been present. The evidence pointed toward insufficient light. An attempt was then made to determine whether the principle of light reduction could not be effectively used in the eradication of perennial weeds like the European bindweed. A number of investigators had already shown that a reduction in light intensity produced plants with attenuated stems, thin walled, loosely organized leaf cells, reduced root development with lessened root reserves, decreased dry matter, stored carbohydrates, moisture content, sugars, sucrose, water soluble nitrogen, ash content. The vegetative and fruiting periods were prolonged. Shaded European bindweed plants lose their normal prostrate form and become twining plants. The literature presents very little information on the effect of shading upon the food reserves in the roots of perennial plants.

Four cages 4 feet wide, 4 feet high, and 6 feet long were made of 2 x 2 fir and covered with hardware cloth except at the bottom and in turn these cages were overspread with cloth which would approximately transmit the amount of light which had been set forth the time the experiment was planned: -

1. Two layers of aster cloth ---- 3400 f.c.
2. One layer of white muslin ---- 1000 f.c.
3. One layer of light canvas (drill) - 600 f.c.
4. Two layers of black cloth ---- below 1 f.c.
5. Control ---------- 10,000 f.c.

The chambers were placed directly over European bindweed plants at Cherokee, Iowa in an area where there was a uniform and heavy infestation of bindweed. The first year, 1937, daily readings were made of the temperature and light intensity; - frequent readings were also made of the evaporating environment. Near the end of the growing season the tops were cut off and weighed.

Measurements of the thickness of the leaves September 1937 were as follows:

No. 1. Two layers of aster cloth ----------.220 mm.
No. 2. One layer of white muslin ----------.210 mm.
No. 3. One layer drill ----------.190 mm.
No. 4. Two layers black cloth ----------.160 mm.
No. 5. Control ----------.334 mm.

European bindweed plants growing in a light intensity of 650 f.c. had a leaf thickness about one-half that recorded for leaves of the same plant grown in the open.

Leaves under decreased light often increase in size and then again the decrease in light intensity may be such as to cause a reduction in the leaf area. The average size of the leaves taken from European bindweed plants in August 1937 were as follows:

No. 1. Two layers of aster cloth ----------8.15 sq. cms.
No. 2. One layer muslin ----------7.15 sq. cms.
No. 3. One layer drill ----------3.76 sq. cms.
No. 4. Two layers black cloth ----------0.69 sq. cms.
No. 5. Control ----------3.21 sq. cms.

The experiment was continued throughout the season of 1937, 1938, 1939, and 1940. The amount of green aerial tissue at the end of each season is given below.

	1937	1938	1939	1940
No. 1. Two layers aster cloth	1389.1	893.8	170.1	4.5
No. 2. One layer muslin	1956.1	248.0	113.4	3.6
No. 3. One layer drill	1418.5	60.2	2.1	0.7
No. 4. Two layers black cloth	992.2	35.5	3.0	65.5
No. 5. Control	1700.9	893.8	1460.8	276.0

At the end of the growing season of 1940, after four years of shading, excavations to a depth of 3 feet were made; the amount of root material and available carbohydrates were measured: -

	Depth	Weight of roots Grams.	Available carbohydrates Grams.
No. 1. Two layers aster cloth	1	35.0	2.53
	2	37.0	2.58
	3	10.75	0.81
No. 2. One layer muslin	1	2.69	0.062
	2	4.43	0.136
	3	1.69	0.165
No. 3. One layer drill	1	1.14	0.032
	2	0.87	0.067
	3	0.56	0.052
No. 4. Two layers black cloth	1	15.05	1.35
	2	33.10	2.63
	3	58.00	3.47
No. 5. Control Open	1	212.0	10.26
	2	202.0	7.39
	3	185.0	9.51

The high values for No. 4 (Two layers black cloth) was due to the encroachment of roots from bindweeds growing in adjoining wheat field. This field had been in wheat for four years. Sufficient space had not been allowed between this shelter and the field.

It is apparent that a reduction in light intensity reduces the amount of stored material in the roots and the greater reduction takes place in the environment where less light is present.

Competitive crops are sometimes designated as smother crops. The growth they produce is such as to compete successfully with weeds by either excluding light or utilizing large quantities of water and mineral nutrients or by limiting the

quantities of all three factors available to weeds. The principal competitive crops are as follows: soybeans, sorghum, Sudan, millet, hemp, buckwheat, sweetclover, sunflower, rape. Of these soybeans, sorghum, Sudan grass, millet have given the best results. The seedings have been made with a grain drill and have necessarily been heavy. Seedings made the early part of June have given good results. The light intensity of these four smother crops on August 20, 1937 2:00 p.m. were as follows:

Sorghum	90 f.c.
Sudan	140 f.c.
Millet	60 f.c.
Soybeans	110 f.c.

A successful smother crop when used to eradicate the European bindweed through light restriction and resulting elimination of root growth must develop sufficient shade early in the development of the plant and retain the environment for an extended period of time.

In 1933 and 1934 we used soybeans for the first time at Hawarden, Iowa along with other smother crops, millet, sorghum, buckwheat, hemp, Sudan, on ground heavily infested with bindweed. It was noticed that in all cases we got a reduction in the bindweed population. Where there were two successive croppings, the control of bindweed was much more effective. It was estimated that in the case of soybeans there had been a reduction in the amount of bindweed to the extent of 70 per cent. When our laboratory was moved to Cherokee, soybeans became our main smother crop. Our method of procedure is now as follows:

1. Plow the grain stubble as soon as the grain is removed.
2. Cultivate the ground at 10-14 day intervals if bindweeds appear and continue until time of killing frost.
3. In the spring cultivate the ground at 10-14 day intervals from the time the bindweed shoots appear.
4. Plow the ground the latter part of May and drill inoculated soybeans at the rate of 3 bushels per acre the same day or next day. Have a good firm seed bed.
5. As soon as the beans have been harvested, plow the ground and follow the same plan as outlined above.
6. Follow plan as given until bindweed has been eliminated. This has taken three to five years dependent upon the extent of the infestation.

By using the plan as given, it has been possible to completely eradicate the bindweed at Cherokee, Iowa in four to five years, where bindweeds have been present since the first World War.

In 1940 an attempt was made to determine to what extent soybeans affected the root reserves of the bindweed growing with the soybeans. A 12 acre field heavily infested with bindweed and giving all appearances of being uniform was chosen for the experiment. The beans were drilled with a grain drill at the rate of 3½ bushels per acre after the ground had been plowed the day before. The beans were harvested for hay by being picked up green and placed directly into a silo. The bean ground was manured and plowed shortly afterwards. If bindweed shoots appeared on the plowing, the ground was cultivated at 10-14 day intervals with a field cultivator.

Two excavations 5 x 5 feet to depth of six feet were made at four different times during the growing season, May, July, September and November and chemical analysis were made for each foot of the excavation, using 25 cubic feet in each case. To date we have the data for 1941, 1942, and 1943. The analysis for 1944 have not as yet been made. By examining the data on the sheets that have been passed to you in Table 1, you will notice that there was considerable variation in the amount of root material in the two excavations of May 1941. There has been a tendency for a greater amount of material in the second foot, than in the first. The data includes the results of 1941 and 1943, and the data for 1942 have been left out.

Table 1. Amount of European bindweed roots in Soybeans planted solid where there was a heavy stand of bindweed in 1940

Depth in Feet	1941							
	May		July		September		November	
1	13.70	70.34	34.40	55.80	6.87	51.89	24.29	5.34
2	13.54	124.54	36.94	106.60	21.00	66.86	15.80	12.31
3	11.02	63.33	34.86	82.17	13.42	24.90	12.35	20.26
4	7.47	27.96	25.62	48.66	17.25	22.65	7.71	14.13
5		20.18	20.52	39.84	9.77	7.44	5.48	10.32
6		5.20	4.84	4.43	3.32	3.99	0.98	3.86
	1943							
1	3.65	6.70	2.4	7.2	4.70	15.65	6.40	6.85
2	8.30	46.69	2.2	15.9	4.50	27.50	7.40	4.50
3	7.30	39.60	2.1	15.5	3.90	19.50	6.50	3.10
4	3.75	26.42	2.0	9.7	5.55	11.95	7.45	1.50
5	4.40	15.15	2.4	6.9	3.15	6.50	5.40	
6	1.10	4.50		2.2	1.70	3.0	3.10	

During the three years that soybeans have been grown on the same ground there has been a marked reduction in the amount of the root material during July but having a tendency to increase in September. This tendency for an increase is due in all probability to a movement of food material from the lower depths. Table 2 gives the complete analysis of per cent sugar, starch, and available carbohydrates for 1941 and Table 3 contains the data for 1943, three years of soybeans. The amount of available carbohydrates is also included for both years.

A hail storm on July 18, 1943 which removed all the soybean leaves and severely injured the stems may have served to increase the root reserves for September 1943.

For all practical purposes as far as control of European bindweed is concerned one could grow a cultivated crop. This last year about two acres of the ground were drilled to soybeans this last year in rows 42 inches apart. There were a few bindweed spots but they did not interfere with the cropping. It is interesting to know too that equally good results have been obtained where beans drilled solid and combined for seed.

Table 2. Chemical Analysis of European Bindweed Roots for the 1941 Season

Sample No.	Depth in feet	Sugar Per cent	Starch Per cent	Total Available Carbohydrates Per cent	Grams
		May 1941			
1	1	7.88	6.31	14.19	1.93
2	2	13.01	12.73	25.74	3.49
3	3	14.07	15.28	29.35	3.23
4	4	14.71	17.34	32.05	2.39
5	1	4.74	5.65	10.39	1.63
6	2	4.75	4.11	8.86	3.32
7	3	5.45	5.69	11.14	3.49
8	4	6.44	10.79	16.23	2.88
9	5	7.10	19.64	26.74	5.91
10	6	8.50	24.13	23.69	2.32
		July 1941			
11	1	3.43	3.53	6.96	2.40
12	2	3.63	4.70	8.33	3.08
13	3	3.98	7.55	11.53	4.02
14	4	4.17	12.35	16.52	3.22
15	5	5.07	17.94	23.01	4.72
16	6	8.78	14.52	23.30	1.17
17	1	9.39	6.10	15.49	8.64
18	2	9.26	6.39	16.19	17.26
19	3	7.97	10.42	28.39	24.33
20	4	6.44	15.98	22.42	10.91
21	5	9.50	21.97	31.47	12.54
22	6	11.06	24.22	35.28	1.56
		Sept. 1941			
23	1	7.20	7.30	14.50	1.00
24	2	7.76	6.44	14.20	2.98
25	3	5.40	5.59	10.99	1.48
26	4	5.32	7.98	13.30	2.29
27	5	5.67	8.39	14.06	1.37
28	6	6.58	6.40	12.98	0.65
29	1	11.26	9.98	21.24	11.02
30	2	9.88	9.47	19.35	12.54
31	3	12.40	11.54	23.94	5.96
32	4	12.09	11.97	23.88	5.39
33	5	11.91	22.28	34.19	2.54
34	6	11.46	8.91	20.37	0.81
		Nov. 1941			
126	1	16.69	4.75	21.44	5.21
127	2	16.47	6.81	23.28	3.70
128	3	16.55	8.62	25.17	3.11
129	4	16.34	12.54	28.88	2.23
130	5	15.49	10.75	26.24	1.43
131	6	14.75	12.00	26.75	0.26
132	1	15.78	6.31	22.09	1.18
133	2	15.05	3.37	28.42	3.50
134	3	9.29	3.10	12.39	2.51
135	4	7.46	4.40	11.86	1.68
136	5	6.15	5.63	11.78	1.21
137	6	5.83	6.40	12.23	0.38

Table 3. Chemical Analysis of European Bindweed Roots for the 1943 Season

Sample No.	Depth in feet	Sugar Per cent	Starch Per cent	Total Available Carbohydrates Per cent	Grams
			May 1943		
1	1	8.95	4.20	13.15	0.50
2	2	10.19	2.35	12.54	1.04
3	3	9.86	2.66	12.52	0.92
4	4	7.85	3.16	13.01	0.49
5	5	7.87	5.10	12.97	0.57
6	6	5.46	5.16	10.62	0.12
7	1	7.46	5.82	13.28	0.89
8	2	7.45	4.12	11.57	5.52
9	3	8.42	3.44	11.86	4.70
10	4	8.31	6.55	14.86	3.93
11	5	8.40	13.44	21.84	3.84
12	6	8.26	19.32	27.58	1.24
			July 1943		
13	1	6.22	10.73	16.95	0.41
14	2	*	10.13	*	0.22 (S)
15	3	*	9.59	*	0.21 (S)
16	4	*	4.85	*	0.10 (S)
17	5	*	4.04	*	0.10
18	1	4.01	3.44	7.45	0.54
19	2	3.00	2.99	5.99	0.95
20	3	2.74	4.06	6.80	1.05
21	4	1.78	5.91	7.69	0.75
22	5	3.22	3.80	7.02	0.48
23	6	2.24	9.94	12.18	0.27
			Sept. 1943		
24	1	6.25	7.85	14.10	0.66
25	2	5.74	9.65	15.39	0.69
26	3	7.88	10.93	18.81	0.73
27	4	6.81	7.71	14.52	0.81
28	5	7.29	13.18	20.47	0.65
29	6	9.35	15.62	24.97	0.42
30	1	5.79	6.31	12.10	1.89
31	2	5.51	7.28	12.79	3.52
32	3	5.55	8.00	13.55	2.64
33	4	5.68	8.94	14.62	1.75
34	5	6.25	7.31	13.56	0.88
35	6	7.41	9.44	16.85	0.52
			Nov. 1943		
39	1	*	8.19	8.19 (S)	0.52
40	2	6.75	9.64	16.39	1.20
41	3	6.10	8.00	14.10	0.92
42	4	3.48	8.19	11.67	0.87
43	5	*	8.54	8.54 (S)	0.46
44	6	*	7.37	7.37 (S)	0.23
45	1	13.38	10.79	24.17	1.65
46	2	11.91	10.29	22.30	1.00
47	3	10.30	20.50	30.80	0.96
48	4	11.28	17.40	28.68	0.43
49	5				
50	6				

* Insufficient material for analysis.

28362jh-1/45

We have stressed soybeans for Iowa, as they are more profitable than the other crops. Bindweeds have been exterminated where sorghum and Sudan have been grown consecutively for five years.

Mr. Zahnley: Is there any discussion?

Mr. Renne: Have you ever used wild hemp to smother your bindweed?

Mr. Bakke: No, we haven't particularly used wild hemp, but we have used hemp of the same species. The results have been very poor.

Mr. Renne: I have had a lot of experience with weeds. I have been quite successful with wild hemp. I have another remedy that has also been very successful. If I told you the way it is done, you wouldn't believe it, so I won't tell you. I am very much interested in this meeting from a farmer's standpoint. It is very gratifying to know that our weed problem is getting so much attention. I stumbled on this other method of eradication quite by accident. I believe it would work in eradicating weeds.

Mr. Zahnley: We will now adjourn until 1:15.

SECOND SESSION - November 17

Mr. Bert Mott of Hastings, Nebraska, President of the Nebraska Crop Improvement Association and Member of the Nebraska Weed Advisory Committee presided in the absence of Director W. H. Brokaw, Director, Extension Administration, University of Nebraska.

Mr. Mott: I am replacing Mr. W. H. Brokaw, who is unable to be here until later in the afternoon. The first speaker for this afternoon is Professor T. K. Pavlychenko, Department of Plant Ecology, University of Saskatchewan, who will talk on "The Optimum Depth for Germination of Weed and Grain Crop Seed in Relation to Weed Control in a Growing Crop."

OPTIMUM DEPTH FOR GERMINATION OF WEED AND GRAIN CROP SEED IN RELATION TO WEED CONTROL IN A GROWING CROP

Mr. T. K. Pavlychenko
Research Professor of Plant Ecology
University of Saskatchewan

Nature seems to be always generous in spilling enough weed seeds on any piece of cultivated soil, so as to make it look green even if the farmer fails to put a crop on it. If the farmer is as generous and puts plenty of crop seed into the ground, then plants of the two kinds grow together on the same land, each competing with one another for the growing conditions therein available.

It is a common observation that in some instances weeds take an upper hand over the crop and dominate the land almost to the exclusion of the crop. Sometimes they meet halfway and sometimes the crop smothers the weeds completely.

The physical condition of the soil, amount and location of the soil moisture as well as the biological characteristics of the weed and crop seeds contribute to the success or are responsible for the failure of one of these groups in winning the race.

Among other factors the firmness of the seed bed, the amount and location of soil moisture, the speed of the germination process in the weed and crop seeds after the crop is sown, and the ability of the seeds to emerge from certain optimum depths are the most important ones.

Unlike with the intertilled crops, the past and present system of grain farming leaves little or no opportunity to the grower to destroy weeds after the grain is planted.

Numerous attempts throughout the world, with harrowing crops soon after emergence, only occasionally proved to be of some value even on the same soil and with the same crops. Mostly the practice was ineffective to weeds and quite injurious to the crops. For this reason it never was accepted as a standard practice of farming anywhere.

Rodweeding of the grain fields before the crop emerged sometimes is definitely beneficial. The uncertainty of penetration of the implement frequently resulting in damage to the crop from the tearing action of the rod standards as well as from the rod itself, however, prevented the practice from being widely used.

Besides these two well known but rarely applied practices no other means of combating the weeds in the growing crop by practicable cultural methods so far have been devised. It is therefore safe to state that whatever success we have in raising our grain crops in spite of weeds, is primarily due to the ability of our crops to overrate the weeds in developing more efficient root systems in the ground and in producing a better top growth ahead of the weeds during the first months after emergence. The destruction of weeds during the summer fallowing years and particularly prior to seeding of the grain crops has an important bearing upon the conservation of soil moisture and the decrease of weed seed population in the ground, but not necessarily upon the intensity of plant competition on the land thus treated and immediately seeded to grain crops.

From the day the grain crop is planted the crop and weed plants generally are left free to act as they may. The farmer feels helpless in extending his weed control measures beyond the day when the grain is sown.

At this laboratory it was possible to demonstrate quantitatively that the degree of success which our crops exert in combating weeds associated with them usually is in proportion to the size of the root systems and top growth which they develop during the first month after emergence to the similar structures of the weeds concerned.

It is assumed, therefore that an effective method for controlling weeds in a growing crop must be such as to render itself applicable at sometime after the crop is planted.

With these thoughts in mind the question was raised in 1931: Is there any further chance for the grain grower to assist his crops in overcoming the dangers of being overgrown by weeds during the period from seeding to maturity? In response to this fundamental question several projects were initiated at this University between 1931 and the present time. All of them had as their objectives investigations of biological characteristics of different weeds and crops grown in the field under various moisture conditions at Saskatoon. Of these projects the competition between weeds and crops; the root systems of weed and crop plants; the speed of the germination process in the weed and crop seeds; the assimilation of leaf surface in weed and crop plants; and the optimum depth for germination of the weed and crops seeds under field conditions were studied in considerable detail. In this paper some results obtained over a period of eleven years from a project on the optimum depth for germination of weed and crop seed in relation to weed control in a growing crop, will be discussed.

The project as a strictly experimental undertaking was initiated in 1931 and was carried on continuously up to 1941. During that period there were some very dry years - as 1933 and 1937. Some years were more or less normal - as 1935, and some seasons - as 1938, might be termed wet considering the long time average for Saskatchewan.

Throughout this period seeds of 18 species of the most common and serious annual, biennial and perennial weeds and 5 standard cereal crops were tested with respect to their ability to germinate and produce top growth under field conditions when planted at various depths under the surface. The "optimum depth" for germination in this discussion is used to indicate the depth range embracing the optimum depths over the eleven year period for the weeds and crops studied.

Methods

In this work all the large seeded cereals and weeds were planted at 28 different depths from one-half inch to 14 inches below the surface with one-half inch difference between individual plantings. The small seeded weeds and crops, however, were planted only at 12 depths from one-half inch to 6 inches below the surface. At each depth the crops and weed seeds were planted in quadruplicate plots each consisting of one hundred plantings. The records were taken each day from the first emergence to the last one. In the check plots the seedlings were destroyed on the day of emergence in order to prevent the recorder from counting them twice. In addition colored wire sticks were left in place of the destroyed seedling to recheck the book records after the test was completed. In the experimental plots the seedlings were also counted at the same time but left to grow to maturity. From these plots data on the progress of plant development, fields, and dry weights were secured.

The results secured from individual species in this test, made it possible to classify the species into convenient groups in accordance with the optimum depth for germination over the eleven year period.

The four principal large seeded grain crops, namely, wheat, rye, barley, and oats, and the two weeds, namely, wild oats and common darnel, constituted one distinct group. It was characterized by a wide range of optimum depths lying between 2 and 4½ inches below the surface, depending on the season. In good years the seed of these crops and weeds has germinated readily from shallower depths also. In dryer years, however, the germination was uncertain and very uneven. Under all conditions they produced a considerable amount of germination from depths much greater than the optimum (4½ to 13 inches) but the time from seeding to emergence was too long to be of practical value to farming.

The small seeded annual, biennial, and perennial weeds, together with flax, constituted the second group. This was characterized by its optimum depth range lying close to the surface, approximately between one-half and two inches in depth.

Weeds such as Russian thistle, on the one hand, and such as cow cockle, on the other hand, differ considerably in their preferred depths from which they germinated best. In moist seasons the former germinated most readily from very shallow depths starting directly from the surface. The latter germinated much better when planted at 2 inches below the surface and frequently emerged from 4 to 5 inches in depth.

Fortunately the optimum depths for germination of most of the small seeded annual, biennial, and perennial weeds was confined to depths of 2 or less inches below the surface.

The field grain crops, on the other hand, with the exception of flax, have their optimum depth between 2 and 4½ inches below the surface.

The yield results were interesting and their general trend may be broadly stated as follows: All plants of the first group produced the highest volume of dry matter when planted at depths ranging between 2 and 4½ inches below the surface. These species produced least when planted at greater depths than 4½ inches and an intermediate quantity from all depths less than 2 inches below the surface.

The crop and weeds of the second group produced best when planted between ½ to 2 inches below the surface; least from all the depths below 2 inch level and an intermediate quantity from the depths of ½ or less inches below the surface.

This particular finding seems to justify a hope for developing such a system of grain farming, which would afford an additional opportunity to grain growers for controlling weeds effectively in the growing crops. Preliminary tests in small plots over a period of three years (1941 to 1943) gave every encouragement to this hope. This year, therefore, a field test on a large scale throughout the province was made and it is expected that the results thus procured will give further evidence as to the validity or otherwise of this hope.

At this point it is natural to make some suggestion as to the way that this idea may be implemented into practical farming.

It is fully realized that any measure devised for weed control, to be practical, must not harm the crops, should effectively destroy the weeds, and at the same time conserve the soil moisture, control soil drifting, and must be economical to the farmer. This is a difficult task. Yet in the light of the experience already gained in this respect it seems to be quite within the realm of realization.

The method which is proposed to materialize this idea may be called: A farming system with the seeding of grain crops as the first field operation in the spring with the post-seeding cultivation of the crops thus sown. Such a system of farming seems to comply well with all the precautionary points innumerated above.

The procedure that was followed in this practical phase of the work may be briefly outlined as follows:

In the spring, when the land was ready for field work the grain crops were sown without any pre-seeding cultivation.

Approximately one week after the seeding, when the grain sprouts were about one inch long, measuring from the seed with their growing tips still 3 to 2 inches below the surface, the field received a surface tillage to a depth of 2 inches.

In this manner the weeds, which survived the seeding and those newly germinated after the seeding, were all destroyed.

In two or three days after this operation the crops emerged and generally grew ahead of the weeds for the rest of the growing season. Only in cases when the post-seeding cultivation was done in unusually rainy period some weeds did recover quickly and produced some seed. Results obtained in 1944 from a large scale field test of this system of grain farming may be of interest. These results were obtained in spite of the fact that the post-seeding cultivation was done with a rodweeder which is an implement utterly unsuitable for this kind of work.

The results in Table 1 indicate that with the exception of wheat on stubble land yield of all the grain crops was significantly higher in the plots seeded directly into unprepared soil and rodweeded after the seeding. At the same time the amount of weed seed produced in the plots thus treated on the stubble was reduced by 82 per cent and on the summerfallow 87 per cent as compared with the volume produced in the plots seeded in the ordinary manner.

Table 1. Average yields of grain crops sown (a) as usual and (b) into unprepared soil and cultivated after seeding.

Crops	Pre-seeding cultivation	Post-seeding cultivation	Stubble		Summer fallow	
			Crop Yield bu/A	Weed Yield lbs/A	Crop Yield bu/A	Weed Yield lbs/A
Wheat	Discing	Nil	36.0	243.9	41.9	130.1
	Nil	Rodweeding	32.0 1/	75.2	51.1	9.9
Rye	Discing	Nil	18.5	1052.0	38.0	84.0
	Nil	Rodweeding	23.8	148.2	44.8	18.0
Oats	Discing	Nil	66.4	260.2	79.2	73.5
	Nil	Rodweeding	81.2	32.1	87.1	4.1
Barley	Discing	Nil	34.5	417.2	56.7	14.0
	Nil	Rodweeding	50.8	50.2	60.0	8.2

1/ Wheat is susceptible to injury by the rodweeder. The stand of the crop was reduced and this resulted in the lower yield from the rodweeded plots.

These differences were obtained in 1944, which was somewhat above average with respect to the precipitation particularly during the earlier part of the growing season.

In drier seasons the differences are still more accentuated in favor of the crops. This method of grain farming

(1) Brings a better return to the farmer,
(2) Effectively controls weeds at least to the extent of 80 per cent due to the post-seeding cultivation,
(3) Conserves soil moisture for the crops by eliminating disturbance of the soil before seeding,
(4) Prevents soil drifting by leaving some weeds undestroyed after the seeding,
(5) It requires an equal amount or frequently less work than an ordinary way of seeding.

From time immemorial and up to the present day the tiller of the land has been doing his best to destroy weeds on the land before it is seeded. He felt helpless, however, to do any harm to the weeds after the crop was in the ground for the fear of damaging it. The proposed system of grain farming offers a definite opportunity to the grain grower to extend his controlling action against weeds beyond the date of seeding without making any additional sacrifices either in the way of cost or personal labor.

It is true that some technical difficulties must be overcome first before the system may be safely recommended to the average farmer. First of all the unprepared soil is much harder for the seeder to penetrate to a desired depth than is the soil previously cultivated. Tiller combine probably is the only type of seeder now available on the market that would meet this requirement more or less satisfactorily. Seed drills of other makes would not evenly penetrate and plug readily on account of their discs being spaced too closely.

At this laboratory the difficulty was overcome by reconstructing an ordinary Massey Harris hoe drill. The hoes which on the original make were fixed in two gangs spaced only 10 inches, one behind the other, were arranged in three gangs each at 18 inch intervals behind the front ones. In this way each hoe was spaced more than 18 inches in all directions. With this reconstruction the drill penetrated easily down to four inches into unprepared soil and cleared any amount of weeds or trash.

Another and a much more important and serious difficulty arises from the fact that so far there is no satisfactory implement on the market for a shallow surface tillage of a required depth. The implements available at the present time for surface work were all designed for the destruction of weeds on the unseeded soil. For this reason the designers were justified in not paying due attention to the mechanism controlling the depth of operation. With this system of farming, however, the depth control is of primary importance. Such implement must yet be designed before the method may be generally recommended. Personally I think the prospects of developing a suitable machine for this work are not at the present time hopeless.

Mr. Mott: Thank you Professor Pavlychenko. We will now hear from Mr. N. S. Hanson of the Department of Agronomy, University of Nebraska, on "Erosion Control as Applied to Weed Eradication".

EROSION CONTROL IN RELATION TO WEED ERADICATION

Mr. N. S. Hanson
Assistant Professor
University of Nebraska

In 1930 the report of the Agricultural Service Department Committee of the U. S. Chamber of Commerce listed 30 important items of annual waste on American farms. In this list soil erosion was first and weeds second. The loss from weeds was $3,000,000,000.

Gentlemen, we are concerned in this Conference with a very serious agricultural problem which is the second most important loss to the American farmer - WEEDS. But, let us not forget that in our anxiety to exterminate this menace we may be guilty of encouraging the ravages of the worst enemy that the farmer can have - SOIL EROSION.

Some of the states represented in this Conference perhaps are not affected as much by losses from soil erosion as in Nebraska and perhaps some states are more affected by it, but, nevertheless, I believe the agriculture in every state is affected more by this serious menace than the average citizen realizes.

The tendency has been to recommend measures for as rapid extermination of perennial weeds as was possible. After it was discovered that perennials such as bindweed could be eradicated by intensive fallow for two or more years, that practice was adopted and has been used extensively. In areas where the land is quite level, where the soil is not subject to wind erosion, and where gully-washing rains are uncommon, the bare fallow method can still be used quite successfully without special protection for the soil. On the other hand, in areas such as Eastern Nebraska where the topography is gently to steeply rolling and where 2, 3, and even 4 inch rains within a few hours are not uncommon, it is very necessary to employ erosion control practices along with weed eradication methods.

I shall attempt, with colored slides, to show you some of the erosion that has resulted from bare fallow for bindweed eradication in Eastern Nebraska and what practices we are testing to combat this problem.

I should like to make this point clear that even though some of these practices have been proven successful by the Soil Conservation Service for use under general farming conditions, they are still largely experimental where we are combining them with weed eradication methods. These studies are not as yet complete, but we are of the opinion that some of them will be successful and the only reason for reporting this work at this time is to show what we are trying to do in solving this serious problem.

Furthermore, I shall be talking a great deal about subsurface tillage, a much talked of subject since the appearance of "Plowman's Folly." I want to point out that it shall not be my attempt to discuss the pro's and cons of this system versus plowing for seedbed preparation, but only to show where this system of farming can be used to advantage for erosion control and weed eradication in combination with cropping systems.

These slides deal entirely with cultivation for the eradication of bindweed, but I think we will find that the same erosion control practices can be used for other weeds as well.

Slide No. 1. The first scene is one that perhaps is not uncommon to many of you who have seen the effects of bindweed on corn. Losses in corn in Nebraska will run from 100 per cent on such heavily-infested areas in years of unfavorable moisture to almost zero on otherwise well-farmed land in years of adequate rainfall such as the present. I had to show you this picture to impress on you the luxuriousness of our Nebraska bindweed and its tremendous flowering and seed producing potentialities as are shown in the second slide.

Slide No. 2. This picture shows an area of about 1½ to 2 square rods. Definitely a wolf in sheep's clothing, isn't it?

Slide No. 3. This picture also is one that is not uncommon to those of you who have used a duckfoot cultivator for eradicating perennial weeds. This type of machine does a very fine job of covering the ground and cutting all the shoots. On land that is level and not subject to serious wind or water erosion, the duckfoot is still a very important machine for killing weeds. However, on land that is subject to serious erosion it is not possible to leave crop residue on the surface with this machine because the shanks are so close together that they have all the effectiveness of a good rake. For that reason we are recommending the use of machines with wider spaced shanks.

Slide No. 4. We are all familiar with the fact that the lighter soils are subject to wind erosion. In most of the Great Plains states the heavier soils are also subject to wind erosion as soon as the surface becomes dry and there is no protection against the wind.

The picture shows a common farm practice that encourages wind erosion, that of burning a weed-filled stubble. In this particular picture the stubble was burned on April 26, 1937. The next slide shows the effect.

Slide No. 5. Twenty-four hours later the surface soil was being whipped up by a 25 mile per hour wind.

Slide No. 6. This picture shows the effect 48 hours after the stubble was burned. The soil was drifted up behind clods of dirt and remaining weeds like snow behind a snow fence.

We have actually found bindweed seedlings growing from drifted soil indicating that bindweed seed is transported by wind most likely by rolling along the surface or by movement of parts of the plant containing seed capsules. Here is another good reason for erosion control.

Slide No. 7. The serious effect of bare fallow for weed eradication on land subject to erosion is illustrated. This field in Eastern Nebraska had been cultivated at 2 week intervals with a duckfoot cultivator. Apparently a satisfactory job of eradication was being done. Here is how the field looked after a heavy rain. Both sheet and gully erosion had carried away many tons of good top soil, the product of centuries of decaying vegetation and soil building. Such destruction must be prevented or the eradication program will fail in that a worse condition is created than was prevalent in the first place.

Slide No. 8. This picture was taken on our experiment farm at Lincoln. In the foreground is a plot that had bare fallow at 2 week intervals in 1943. It was left bare during the winter. This spring (1944) during the month of April we had 9.81 inches of rainfall. This picture was taken after that rainy spell was over. Here you see the result on a 5 per cent slope. In the background is a residue covered plot. These gullies worked back up the hill to the residue and then stopped. No gullying or even rilling was prevalent on the residue covered plot.

I would like to point out here that the same machine with 30 inch sweeps was used for cultivating both plots. The one in the foreground had been cultivated all the previous year and the residue completely decomposed. The plot in the background had been cultivated only since harvest. After the residue wears out subsurface tillage also becomes bare fallow. It is then necessary to replenish the residue.

Slide No. 9. If bare fallow must be practiced it should be done on the contour between terraces.

Terraces constructed with moldboard or disk plows are cheaply built and carry excess run-off without damage. They should be built carefully and at the proper interval and gradient. Cultivation should be performed parallel to the terrace and never across it.

Slide No. 10. We will now enter the subject of subsurface tillage. A large portion of the experimental work on this method of tilling the soil has been done at Lincoln, Nebraska by the Research Division of the Soil Conservation Service under the direction of Dr. F. L. Duley and Mr. J. C. Russel. A number of the slides following show machines and methods devised under their supervision. We have combined a number of their methods of erosion control into our weed eradication research.

This slide shows why bare fallow is readily subjected to erosion. This is a section of surface soil about one-half inch thick. On the very surface is a tightly-packed film caused by an assortment of fine soil particles. This film is formed on bare ground by the packing action of raindrops falling on the surface soil as well as by an assorting of particles when the water flows over the surface. The result is a reduced intake of water into the soil causing the water to run off. The run-off water accumulates in depressions, and a gully is initiated.

Residue on the surface not only prevents the formation of such a film, but also decreases the intensity of the run-off, causing a greater percentage of the water to be absorbed than on bare fallow.

Slide No. 11. The effect of residue management is illustrated here:

Method	Moisture stored inches	Run-off inches	Erosion Tons per acre
Residues, subtilled	3.78	.60	.97
Residues, Disked	1.96	1.39	6.24
No Residues, Disked	1.03	1.97	13.04

The residue provided was 4 tons of straw per acre. Disking the residue into the ground is more effective than leaving the ground bare. The greatest protection resulted where the residue was left on the surface.

Slide No. 12. This is the principle of the subsurface tiller. Here is a sweep that measures 30 inches from heel to heel. The shank is constructed as thin as possible, but still retains durability and a rolling coulter runs ahead of the shank to cut the residue. These machines will not operate satisfactorily without the rolling coulters. They are as much a part of the machine as are the sweeps.

Slide No. 13. There are a number of these wide-sweep machines on the market. Here is one make. Here again you see the principle that was pointed out before. This is also a 30 inch sweep mounted on a thin shank and has the rolling coulter for cutting the residue. The tines mounted behind the sweep are for assisting in pulverizing the soil. Another feature that is increasing the effectiveness of some of these machines is to have the point turned down slightly to give suction into the ground in much the same way that a plow share sucks in.

Slide No. 14. In this picture you see an integrally mounted subsurface tiller with 24 inch sweeps. Here it is operating very satisfactorily through a heavy growth of second year sweetclover and bindweed.

Slide No. 15. This is a convertible machine. It is a two row lister from which the bottoms have been removed and 44" sweeps mounted. This makes a cheap and satisfactory subsurface tiller.

Slide No. 16. The experimental work in Nebraska from 1936 to 1941, as many of you know, was carried on at York under the supervision of Mr. Lewis Evans, known to many of you as "Jack." The project was under state and federal cooperation at that time. Mr. Evans carried on a large number of experiments and much fundamental information was obtained from his research. As a result of his cultivation and cropping experiments we are recommending two different cropping methods for bindweed eradication. The first we call the alternate crop and fallow method and the second is the continuous crop and fallow method.

In the first method we cultivate at 2 week intervals the first and third years and crop with either winter wheat or rye the second and fourth years. Cultivation is carried on intensively at 2 week intervals after harvest in the crop years.

In the second method we cultivate at 2 week intervals only the first year and crop continuously to wheat in succeeding years with intensive cultivation at 2 week intervals between harvest and seeding until the bindweed is eradicated.

In the York experiments the first method required 4 years with a loss of two crops and the second method 5 years with the loss of one crop.

In the picture you see the method by which we are handling bindweed after harvest. The first cultivation is performed immediately following harvest and at 2 week intervals thereafter. The combine stubble is left on the surface for erosion control.

Slide No. 17. If the grain is harvested with a binder it may in some cases not be possible to cultivate until the shocks have been removed. By using two outfits it is possible to alternate rounds with the binder and subsurface tiller and thereby get the cultivation done immediately after harvest. By this method annual weeds can also be destroyed before they can sap the soil of moisture.

Slide No. 18. On the right hand side of the picture is the field that was being combined and cultivated in the picture just before the last. The straw has been

worked down with a machine which is called a treader. It will be shown in the next slide. Small gullies or rills have worked up to the residue covered ground and stopped. The field on the left had been cultivated all season and part of the previous season and the residue was completely decomposed. A cover of stubble like that on the right will last through six to eight cultivations depending on how much of it gets covered each time.

Slide No. 19. This machine is the one that I have referred to as a treader. It is a rotary hoe run in reverse so that the hoes tread the weeds and residue down rather than pull them out. The hoes break the soil loose from the annual weed plants and lay them down on the ground where they wilt and die. This adds another operation in some cases, but it is not necessary to go over the ground after each cultivation. It is used only when it is necessary to kill annuals. The next slide shows the result.

Slide No. 20. The plot on the left was treaded after cultivation. The one on the right was not. The weeds on the left have wilted. Those on the right continued to grow.

Such annual weeds growing on cultivated land may seem undesirable. Actually to a certain point I think they are beneficial so long as the bindweed does not stay alive. This growing vegetation, while it looks unsightly, adds to the residue when it is treaded down and it aids some in preventing run-off while it is growing. These annuals should not be left to grow until their moisture requirements become excessive and should be killed by treading several weeks before a crop is planted.

Slide No. 21. Waterways and gullies are perhaps the bigger problem to contend with in erosion control when they are full of bindweed or other perennial weeds. Such waterways should ultimately be seeded to grass with terraces dumped into them. There is some question as to whether the bindweed should be eradicated first or if the waterways should be seeded down first, the bindweed eradicated from the rest of the field, and then the waterway be cleaned out.

It has been our opinion that, in order to prevent the spread of weed seeds further down the waterway on adjoining farms, the waterway should be taken care of first and seeded after the bindweed has been eradicated. The following slides will show how we are trying to accomplish eradication in waterways.

Slide No. 22. In the first method we start by subsurface tilling either a weed or crop residue in the spring.

Slide No. 23. As the residue becomes decomposed through the summer, annual weeds assist in holding the soil. These in turn are treaded down and killed to furnish what residue they will. Residue can also be provided by mulching with straw.

Slide No. 24. The waterway is then planted to winter wheat in the fall and the crop harvested the next year. The waterway is subsurface tilled from harvest to seeding time and again seeded. In other words the continuous crop and fallow method mentioned earlier is used and after the bindweed has been eradicated the waterway is seeded to grass.

In this picture you see a crop of wheat growing in the waterway. The residue in the foreground was washed down and deposited from a 50 to 60 acre watershed on an adjoining farm during a heavy rain. The wheat held the residue and soil in place.

Slide No. 25. Forage sorgo or Sudan grass provides good protection for a waterway and the stubble is very resistant to decomposition, thereby making a good residue if one prefers to cultivate the following season. We are experimenting with continuous cropping to sorgo and alternate sorgo and fallow for bindweed eradication to see whether this method will work out for waterway control and bindweed eradication.

Slide No. 26. The bindweed growing in the sorgo is usually spindly and chlorotic. Very few plants were found that had produced blossoms and seeds and those only where the sorgo stand was thin.

Slide No. 27. We cut our sorgo with a grain binder and leave the stubble as tall as possible to furnish a heavy residue.

Slide No. 28. The last slide is somewhat theoretical, but it shows a system by which we believe that ultimately large acreages of bindweed or other perennial weeds can be eradicated in Nebraska.

This is the alternate crop and fallow method in a strip cropping system. We'll assume that the eradication program on this field was started in the spring of the year and this picture was taken immediately after harvest. The contour lines were run the fall before and alternate strips were seeded to wheat or rye. The other alternate strips, which are fallowed, were left in small grain stubble from the previous crop. In the spring, the alternate strips not in crop were started into cultivation and continued at 2 week intervals throughout the season and seeded to wheat or rye in the fall. The strips in wheat shown here were harvested and will be cultivated by subsurface tillage until fall. They will be in fallow all the next year and seeded the next fall. These strips will be alternately cropped and fallowed until the bindweed has been eradicated. The waterways should be cropped either continuously to wheat or rye after one year of subsurface tillage or cropped to forage sorgo.

Terraces should be constructed on the contour lines at the proper intervals in the fall of the first year.

After the eradication program is completed the waterways should be seeded and the strips put into a good rotation including winter wheat and a mixture of bromegrass and alfalfa to take care of the bindweed seedlings as they emerge.

Gentlemen, this whole procedure may seem very theoretical, but it represents the things that we are studying to try to find the answer for a combination of weed eradication and erosion control and thereby strike simultaneously at the two worst enemies of sound agriculture SOIL EROSION and WEEDS.

THE CONTROL OF WEEDS WITH ELECTRICITY

Mr. Bruce J. Thornton
Associate Botanist
Colorado State College

(Mr. Thornton was prepared to present this information to the Conference, but during the course of the program his report was overlooked. Mr. Thornton has very kindly submitted a copy for inclusion in the report of proceedings.)

The efforts of Mr. G. M. Baker and Mr. H. N. Snyder of Wheatland, Wyoming to develop an efficient and practical machine for the destruction of perennial noxious weeds by electrocution are worthy of comment. The writer first became aware of this effort when reported by Mr. Baker at the Wyoming Annual Seed and Weed Conference in December of 1943. Two trips were made into Wyoming during the summer and fall to observe the equipment, its operation, and the results obtained.

The killing of weeds with electricity is not new. Two machines similar in construction to the ones developed by Baker and Snyder had previously come to the writer's attention. There may be others. One of these machines was tested on the Yuma irrigation project in Arizona. It was originally developed to fix nitrogen in the soil and its weed destroying possibilities were determined later. Apparently being improperly designed the equipment heated badly and finally the generator burned out completely when operating in wet soil. Reliable sources, however, report that in some instances bindweed was killed one hundred per cent, on other cases the resul[illegible] poor, thus indicating the possibilities and at the same time the difficulties associated with developing a method of electrical weed control. Reports regarding the other machine came from California and were less encouraging.

Although the Wyoming equipment was developed without knowledge of the existence of the earlier machines, the principles involved are essentially the same. However, devices for applying the principle do differ considerably and these, together with certain other features, may mean the difference between failure and success.

The first machine developed by Baker and Snyder consisted of a 5 kva 110 volt generator powered through a jack shaft operated through v-belts from the front of the truck motor which also propelled the machine. The output of the generator was led to a transformer which delivered the current as supposedly 12,000 volts. This current was delivered to a wire-fingered brush (actually a section of a side delivery rake) approximately four feet wide which traveled over the surface of the ground thus contacting the foliage of the plants growing thereon. The circuit was completed by means of ground connection consisting of a cut-away disc which cut into the ground to a depth of about 3 inches.

A second machine consisted of a larger truck frame and the generator was powered by a separate 40 h.p. motor. This motor drove a 25 kva generator delivering 2,300 volts, which in turn was connected to a transformer delivering 13,000 volts. The plans called for one terminal to be connected to a spring wire brush and the other terminal to be connected to a similar brush running parallel to the first brush and some few feet away.

Measuring instruments to show voltage or current output were not attached at the time of inspection. It is suspected that these values might vary considerably from the rated amount. Both machines have been improved since these observations were made.

A hasty review of the literature reveals very little technical investigation to have been made relative to the possibility of killing weeds with electricity. A limited amount of work conducted by the U. S. Bureau of Agricultural Chemistry and Engineering in cooperation with the Utah Agricultural Experiment Station attempted to determine some of the fundamentals involved but the project was not completed. It was determined, however, that the resistivity of soil, even when moist, was much greater than that of bindweed rootstocks, that it required as much as 0.2 amperes per square centimeter to kill some rootstocks, that young rootstocks were less susceptible, that differences in voltage had no appreciable effect on the

amount of current required, that if the entire cross section of the soil must be subjected to the current density necessary to kill the weeds the amount of current required would be prohibitive.

Results observed after treatment with the Baker and Snyder equipment were such as to add support to the possibility of killing weeds with electricity. Both bindweed and Canada thistle areas showed an apparent kill of about 95 per cent with additional treatment to be made. These observations were made the same season the areas were treated and therefore are not to be regarded as final. The actual results can better be determined by next season's observations. However, the removal of some of the roots by digging indicated the killing effects to have reached a considerable depth in the particular instances observed.

The makers of the equipment are satisfied with the results to the extent that they state they are willing to guarantee 100 per cent kill of Canada thistle. They are not quite ready to go that strong on bindweed although satisfied that they can approach it very closely. They state that an average of four applications is necessary for the treatment of bindweed and three applications for Canada thistle and place the cost of $10.00 per acre per application the total cost varying with the number of applications required.

Some rather interesting angles have developed. Some roots were found killed from a certain point on down but alive above that point. Others showed short lengths of living roots in otherwise killed roots. Green leaves were being produced at the ends of dead rhizomes coming from partially killed roots, recalling the experiment in physiology where the tomato plant survived after killing a section of the stem with boiling water. A rather superficial observation indicated the parenchymatous stem involving the cortex and probably the phloem to be particularly affected.

Mr. Baker and Mr. Snyder should be commended highly for the progress they have made in developing means of killing weeds by electricity. However, much more effort must be expended to prove the practicability of the method. The results to date appear to warrant careful technical investigations of the fundamentals involved.

Mr. Mott: We will now hear from Mr. J. R. Fleetwood of the University of Missouri on "The Function of the Extension Service in Weed Control Work".

THE FUNCTION OF THE EXTENSION SERVICE IN WEED CONTROL

Mr. J. R. Fleetwood
Extension Specialist in Farm Crops
University of Missouri

It seems quite likely that the committee who developed the program for this conference expected the subject assigned to me to be disposed of in one, two, three order. As a matter of fact, I must confess that when I accepted the assignment I was sure that this could be done. To those of us who have spent most of our working lives in the Extension Service the answer could be simple and short. We have had drilled into our very souls that the function of Extension is to teach people better farm and home practices. To us then the answer could well be to teach farm people better practices in weed control.

A deeper consideration, however, brings out some points it may be well to discuss in a more comprehensive way. There may be some in this conference who do

not fully understand just what the Agricultural Extension Service is and how it functions. No one will question, I believe, the statement that the function of Extension is different in a state with an elaborate weed control law than in a state where no such law exists. Also, the actual weed problem varies between states and this within itself causes a vast difference in weed control programs. Finally, there are a number of different groups interested in the whole problem of weed control. At this conference we have representatives of the U. S. Department of Agriculture, state Colleges of Agriculture, state boards of agriculture, seed analysts, manufacturers of weed chemicals, machinery, and supplies. It is essential that each of these interested groups fit into this picture with as little overlapping and as near no gapping as possible.

May we then discuss each of these situations or factors as they may affect the subject under discussion.

The Agricultural Extension Service is an educational agency set up cooperatively by the U. S. Department of Agriculture, the state College of Agriculture of the state in question, and the local people of the particular county involved. It was designed to carry out or extend the information of the U. S. Department of Agriculture and state Colleges of Agriculture to the farm people. The reciprocal objective was to bring back to the research worker the reactions and problems of the farmer. The key man in this organization is, of course, the county agent, who represents the U.S.D.A. and the college, but who also knows the people personally and can deal with them on a more intimate basis. As set up at present, the Extension Service has a function whenever and wherever there is information which either the U.S.D.A. or the state College of Agriculture has of value to farmers or when farmers feel that they need information from these sources.

It is not within the scope of this discussion to go into the detail as to how this educational work shall be done. However, they must be considered insofar as they clarify the function of extension in weed control.

The actual teaching methods employed will be necessarily selected upon the basis of the status of the problem of weeds and their seriousness in the state. To illustrate this point, bindweed in western Kansas may well present a different problem than in Ohio. Quack grass is a serious weed in Michigan, but it is relatively unimportant in Missouri. As a matter of fact, we would be glad to have it grow on some of our Ozark soils in South Missouri. We can say, however, that enough educational work must be done to arouse a consciousness of the weed problem, develop an interest in doing something about it, demonstrate to the people that something can be done, and insure their taking the necessary steps to accomplish their aim.

Certainly up to this point the function of Extension is relatively clear. Usually there is no other group active until interest has been built up to a point that farmers are ready to act. When something is being done, however, others become interested, there is a demand for chemicals and equipment and manufacturers enter the field, and farmers may feel that certain enforcements are necessary. At the present time Extension does not have authority in law to enforce action. Therefore, when a stage is reached where a higher percentage of participation is needed or demanded than can be secured voluntarily, an agency of enforcement must be set up. Thus, we have our weed control and seed regulatory bodies coming into the picture. Whenever these agencies come in, the function of Extension does change, but I fear the change is often greater than is desirable. There is still a great educational job to be done with reference to the new law, its operations, and

enforcement. At least part of this educational work is a definite function of Extension. Further, the weeds not included in the legislation are still important and must be handled as before or progress will be in reverse.

With states here in all stages and degrees of the weed problem and the solution thereof, I believe you will agree with me that it is not possible to simply list activities and say these constitute the function of Extension in every state.

In order to get at the various degrees of Extension participation in weed control work in the various states, I wrote to the Extension Agronomists in each state represented or invited to be represented in this conference. The replies (incidentally, I got a complete set of weed bulletins and copies of the weed and seed laws from each state, "and I never asked for them either", I believe that this is the best way to get bulletins. If you write the mailing room they are likely to charge for them but if you write someone on the staff and ask a few questions they'll send you the bulletins rather than answer your questions) indicated a wide variation in programs. To a marked degree it seems the responsibility assumed by Extension is based upon the extent of the weed legislation in the state. In a way, of course, this is to be expected, but how far it should go seems worthy of careful study.

In the first place it seems that a sound rather intensive educational program is basic in the development of an interest in weed control and the demand for an adequate weed control law. Surely the Extension Service has a very definite function in this regard. Since it is seldom possible to secure the adoption of a fully adequate law at any one time, a continuing educational program looking toward the further development of weed control laws seems desirable. Doubtless this is also a function of extension, although they should have the cooperation of the law enforcement agency in this connection.

In the second place it seems to be quite generally true that our weed and seed laws are built up pretty much around the control of certain noxious weeds. Weeds are classified as noxious on the basis of their persistence and damage caused either through reduction in crop yield or quality. Thus, we have weeds running from only slightly harmful to very noxious. In our state, many of us feel, more actual loss is caused by weeds not classed as noxious than is caused by those classified as noxious. There is a definite peril in assuming that because a law has been passed the problem is solved. Actually, there is and will continue to be a large group of weeds causing a high percentage of our total weed losses that are not under weed or seed control legislation. Certainly it would seem that Extension has a very definite function for educational work in this field in every state.

In Missouri we have a very good seed law enforced quite well, but our weed control legislation is very inadequate and almost impossible of enforcement. Doubtless there are other states here in somewhat this same condition. Further, I imagine, there are states represented here who do not now and may never need legislation as elaborate as we find in Kansas and Nebraska. On the other hand, many like Missouri do need a more practical set-up than at present. As the Extension Service in our state we feel that it is our function to carry on the necessary educational program to arouse farm people to demand the enactment of the necessary legislation, develop a satisfactory law, and expect its proper enforcement. At the same time, we should initiate and continually carry a program to meet the problems involved in those weeds not covered in legislation.

I have cited some of the duties of the Extension Service in weed control work. All these are not necessarily well defined, in every case and some may not apply at all in other cases, but I would like to repeat them for further emphasis.

1. The educational phases of the whole problem of weed control must be assumed as a function of Extension.

a. If seed and weed legislation are desirable, the educational work incident to the enactment of these laws is a function as well as is a continuing program for the improvement of the existing legislation.

b. If and when legislation is secured, it should be a function of the Extension Service to give farm people a working acquaintance with the legislation. This should include a knowledge of the law, its scope and limitations, its operation and enforcement. We all appreciate the necessity of a full understanding and sympathy with a law on the part of the public if the legislation is to be fully effective.

c. The Extension Service should continue and possibly expand the program of weed control for those weeds not covered by legislation.

2. The Extension Service should continue to extend the findings of the research departments of the U.S.D.A. and the state Colleges of Agriculture. This should include farm people, enforcement officials, seed analysts, manufacturers of materials and supplies, farm organizations, and others interested.

3. Because of its unique cooperative tie-up between federal, state, and local people the Extension Service should continue its job of liaison between these groups.

Specifically, the Extension Service should continue as its function an educational program on:

1. Pure seeds

   a. Pure, clean seed production.
   b. Cleaning of seeds produced.
   c. Testing of seeds used.
   d. Utilization of seed labels in purchasing of seeds.

2. Mowing of pastures, waste areas, fence rows, etc.

3. Crop rotations to control weeds.

4. Cultural practices to secure weed control.

5. Management practices for weed control.

6. The design and use of machinery in weed control.

7. Demonstrate weed control.

   a. Chemicals
   b. Cultural equipment
   c. Smother crops
   d. Seed cleaning equipment

8. Organization to enable utilization of existing weed control methods.

Outside of the special work which must be done to control certain weeds such as bindweed, Johnson grass, Canada thistle, quack grass, Russian knapweed, hoary cress and similar serious weed pests, weed control must be made an integral part of regular farm procedures. Cropping systems must be developed and changed with weed control in mind. Cultural practices to meet new situations such as the combine problems, subsurface tillage, and erosion control must be developed. Machinery to meet these problems must be designed and demonstrated. Seed cleaning must be made more practical for farmers and good sources of seed must be available and farmers taught their value. All these and many more problems such as new chemicals, new techniques and procedures must be continually brought to the attention of farmers if the desired progress in the whole problem of weed control is to be secured. In my opinion, the Agricultural Extension Service has a very vital function in all this educational work and I know we can depend upon the rest of you to assist us in every way possible. Certainly with all of us performing our official duties as well as our personnel and abilities will permit, there is likely to be a serious weed problem for generations to come.

Finally, in regard to the growing multiplicity of agencies working on weed control and the necessity of their working together, I am constrained to offer the following:

Webster defines function as the natural procedure, official duty of an institution or professional body. Prerogative on the other hand is defined as the priority or advantage over others. A calm appraisal of the activities of some of us would indicate a much keener interest in our prerogatives than in our functions. The function of Extension in weed control is specific enough and the scope is so great that we should spend but little time speculating upon our prerogatives.

Mr. Mott: Thank you Mr. Fleetwood. I am sorry gentlemen that I will have to leave in order to catch my train, but I must be back in Hastings this evening. Mr. Howard Leonard, Director of the State Department of Agriculture in Illinois will now preside over the meeting. Mr. Leonard.

Mr. Leonard: We will now have the committee reports. The first one on the list is The Development of a Post-War Weed Program. Mr. D. L. Gross of the University of Nebraska and Chairman of the committee will give this report.

POST-WAR WEED PROGRAM COMMITTEE REPORT

Mr. D. L. Gross, Chairman
Extension Agronomist
University of Nebraska

In order to avoid duplication, your post-war committee confined its discussions largely to the action phase of the weed program, leaving the research phases to Mr. Timmons' committee, except for a brief discussion of the importance of this phase. Your committee wishes to point out that although some of its recommendations do have a particular post-war significance, all of them are not drawn strictly for the post-war period, whenever that might be. All recommendations are considered worthy of immediate attention wherever and whenever they may be carried out satisfactorily prior to the end of the war or thereafter. Your committee wishes to suggest the following:

Employment of County or Weed District Field Supervisors

In areas where noxious weed infestations are extensive many landowners are not having success with their eradication program. This may be attributed to a combination of causes namely:

1. Inability to do tillage work at the proper time because of the press of other farm work.
2. A lack of understanding of the need for timeliness of operations.
3. Insufficient knowledge of the general principles involved in the methods used.
4. Inability to own satisfactory equipment.
5. The habit of procrastination.
6. Absentee landlords and non-dependable tenants.
7. The need for technical aid especially on land subject to severe water erosion.

This situation has resulted in great losses to landowners because of time and material wasted, crops lost, and in many instances land badly damaged by erosion.

For these reasons the committee agrees that the employment of one or more competent supervisors for each county or weed district, to work with and advise landowners as to their noxious weed problems would greatly advance the program of noxious weed eradication. These supervisors would have the following duties:

(1) Supervise all weed control activities. (2) Advise with landowners and operators and map programs of procedure for individual farms. (3) Supervise the use of county or district owned or custom operated weed control equipment. (4) Keep county or district officials informed on developments and advise with them on procedures. (5) Handle the distribution of chemicals. (6) Conduct educational meetings in cooperation with county agricultural agents. (7) Work with Soil Conservation Service technicians in planning erosion control where the tillage method of weed eradication is used. (8) Cooperate with law enforcement officials in preventing the distribution of noxious weed seeds. (9) Map noxious weed infestations. (10) Work with railway and public highway officials in planning noxious weed control programs. (11) Conduct weed control demonstrations. (12) Cooperate with the research division in weed control studies.

Men employed for this purpose should be approved as qualified by the College of Agriculture and by the Weed Division of the State Department of Agriculture, where such Department is engaged in weed eradication activities.

It is recognized that the employment of any substantial number of such men at this time would not be possible. As a post-war reemployment measure, however, such a program should have special value.

Supervised Operation of Public and Privately-Owned Weed Eradication Equipment

Many owners of noxious weed infested land are not in a position to carry out a weed eradication program. They prefer to hire the work done at specified charges. An operation as exacting as noxious weed eradication either by tillage or by the use of chemicals, cannot be left in the hands of inexperienced operators without competent supervision if satisfactory results are to be expected.

It is suggested therefore that counties or weed districts be urged to obtain and operate such equipment and/or arrange for the operation of privately-owned equipment. Both types of equipment would be operated under the supervision of the district or county. This would not mean, however, that the greater portion of the tillage might not be done by farmer-owned and operated equipment.

This type of program, operated on an extensive basis, would also provide much post-war employment on a project that would bring real benefits to the states and the Nation.

Legislation

One of the primary requirements of a successful weed control program is the matter of the control of weed seed distribution. Legislation in most states is adequate for this purpose if sufficient funds and personnel are made available for enforcement. Concerted action on the part of county and weed district officials requesting legislators and other state officials to give more attention to this phase, should bring about an improvement in this situation. Efforts toward the unification of state seed laws should be continued.

Erosion Control

Much land has been damaged severely by wind and water erosion as the result of clean tillage operations for the control of perennial weeds. It is suggested that

greater attention be given to this problem by research and that in areas where both soil conservation and weed control officials are operating, a coordinated program be carried out.

Procurement of War Surplus Equipment

Since tax-supported institutions are given priority in the purchase of war surplus equipment, and since such equipment can often be purchased below market prices, it is suggested that weed district and county officials procure whatever such equipment as can be used effectively in their weed control program. This might include automobiles, or other transportation equipment, tractors, blades, fresnos or other dirt-moving equipment, and other items. Such equipment can be used effectively in erosion control measures to protect tillage operations.

Financial Support of Weed Control Programs

Since weed control is a public as well as an individual problem, it is suggested that local, state, and federal funds be requested to support organized weed control programs. Such funds might be used primarily for chemicals used in weed control, for research activities, or for the employment of weed control supervisors.

A Comprehensive Research Program is a First Essential to The Progress of Weed Eradication

With the increasing demand for weed control information, your committee believes that any post-war weed control program should contain first of all adequate weed control research, covering all phases of the problem and including all types of weeds. Research programs must be synchronized at all times with current field developments including regulatory problems.

The Educational Phase of the Weed Control Program

Facilitating action. No weed program can be successful without a strong educational program. There are three phases to such a program, namely: (1) The creation of a consciousness of the problem. (2) The desire for action. (3) Facilitating action. Facilitating action may not be strictly classified as education, yet it must be an integral part of it. If our efforts along the educational line are to be fruitful, no educational program, the purpose of which is to stimulate action, can be successful without first removing inpediments to action. Neither meetings, press material, radio, bulletins, nor any of the other educational devices will have much effect unless action is facilitated. Your committee believes that the suggestions already made will do much to break down the barriers that commonly hamper the weed program. This has reference particularly to the employment of weed supervisors who will work directly with individuals in planning their weed eradication program. It has reference also to the supervised operation of equipment by the counties or weed districts, at regular established charges.

Field demonstrations. There is no more effective educational method of inducing action, than the holding of field meetings where certain method of procedures are demonstrated. As many of these as possible need be held or established. These might include the manner of spreading or spraying chemicals, or the effect these have on the weeds; how to control water erosion on clean tilled land by the use of terraces and protected waterways; the effect of smother crops of various types; the need for seedling control and how it may be accomplished; the effect of using impure seed; good and poor tillage equipment, machinery adjustments, etc.

It is suggested that more of the research program be carried out on farms in different parts of the state with the farm operators cooperating. This would serve several purposes. The investigator would become more familiar with the problems as they exist in the field. It would give him a surer basis for his conclusions, and the cites of the various activities could be used for field meetings and demonstrations. Landowners would be more familiar with the methods used and would be in better position to apply them properly if they are successful.

Personal contacts. In an action program, personal contacts between the landowners or operators, and the educational or project leader, are very important. County Agricultural Agents can make many of these contacts, but because their time is taken with so many other matters, these contacts are all too few. The establishment of a weed supervisor in each county or weed district, would greatly facilitate this important phase of the educational program. Leader training schools, short courses, exhibits, posters, contests, etc., are all a part of a well-rounded educational program.

Press and radio. These phases must, of course, be continued as vigorously as may be and with sufficient variability to maintain interest. Perhaps in the post-war period television may become as common as radio today. It is possible that in the near future, we will be listening to and seeing weed identification demonstrations over our television radio.

Motion for Adoption by Gross
Seconded by Wilson
No discussion
Passed

Mr. Leonard: The next committee report is on Research. It will be given by Mr. F. L. Timmons of the U. S. Department of Agriculture.

RESEARCH COMMITTEE REPORT
Mr. F. L. Timmons, Chairman
Associate Agronomist
U. S. Department of Agriculture
Hays, Kansas

Your Research Committee, having summarized the suggestions and opinions received from more than twenty workers engaged in weed research or other phases of weed control, submits the following report as a condensed composite of the thinking of the group on weed research problems in the North Central States Region.

The Value of Past Weed Research to the Agricultural Progress of the Region

As a means of establishing the present status of weed research, it seems appropriate to call the attention of the conference to some of the contributions of weed research in the past to the fund of information now available for meeting the weed problems that impede the progress of agriculture in the region. Research in weed control is a relatively new field. Practically no work had been done 40 years ago, very little had been done 20 years ago, and it has been only in the last ten years that intensive weed research programs have been conducted by a considerable number of state experiment stations and the Bureau of Plant Industry. The following is a

partial list of the more notable accomplishments of weed research -- mostly within the last 20 years:

1. Studies of the seeding habits of certain weeds and of the viability of weed seeds under various conditions over a period of years.

2. Life history and rate of development studies of several annual and perennial weeds resulting in a clearer understanding of the methods necessary for their control.

3. Determination of the seriousness of various weeds by surveys of their extent and by measurement of crop losses due to those weeds.

4. The discovery of intensive cultivation or shoot cutting as a method of eradicating perennial weeds.

5. Studies of the seasonal trends of organic root reserves in field bindweed and other perennial weeds providing an understanding of the effect of intensive cultivation and competitive crops on these weeds.

6. The discovery of the effectiveness of delayed and less frequent cultivation of field bindweed with the resultant saving of approximately half the cost of eradication.

7. The development of effective and practical rotations using competitive crops in combination with intensive cultivation for the control of bindweed resulting in lower costs of eradication and less severe losses from soil erosion.

8. The development of effective cropping systems for the control of bindweed seedlings and preventing reinfestation of the land.

9. The discovery of the herbicidal qualities of certain chemicals, notably iron sulphate, sulphuric acid, sodium arsenite, and carbon bisulphide.

10. The discovery of sodium chlorate as an effective herbicide when applied in solution.

11. The development of the dry method of applying sodium chlorate for convenience, economy, and reduction of fire hazard.

12. The testing of a large number of herbicides including proprietory chemicals to determine their relative efficiency in weed control or eradication.

13. The determination of the optimum dates, rates, and methods for applying the various herbicides to different weeds in different sections of the country under various conditions of soil and climate.

14. The use of differential chemical sprays for the control of annual weeds in small grains and certain forage and vegetable crops.

15. The development of burning as a means of controlling annual and perennial weeds.

16. The effectiveness of pasturing by sheep in eradicating leafy spurge and field bindweed.

17. The development of cropping systems, rotation, and fallowing practices, and the improvement of machinery for the reduction of losses from annual weeds.

The Value of this Conference and of Similar Meetings of Workers Engaged in the Various Phases of Weed Control to the Advancement of Weed Research Programs.

1. The presentation of research papers brings together up-to-date information developed from weed research recently completed or now in progress. The latest experimental results are thus made available to all workers, in most cases in advance of publication.

2. An opportunity is provided for research workers to become acquainted with other workers in the region and to compare their results, methods, and problems to the end that each may develop a clearer understanding of the weed research problems of the region and receive new leads for the solution of the problems in his own state or section.

3. Research workers have an opportunity to meet the workers engaged in the educational and regulatory problems and to study the problems and needs of these programs which research can help to meet.

4. Regular or periodic conferences of weed workers similar to this conference will create increasing and cumulative benefits to both the action and research programs through developing continuity in the exchange of ideas, plans, and information and the consequent better understanding and closer cooperation among the men working in the two closely related fields.

The Advantages of Close Cooperation Among Weed Research Workers.

It is realized that many factors operate to prevent close cooperation between research workers in different states, and that many weed research problems are essentially local in nature and must be worked out independently by the different experiment stations. Nevertheless, it is believed that definite advantages would result from closer cooperation between different state experiment stations and the state and Federal research agencies in the following ways:

1. Frequent communication between research workers in the different states comparing the experimental plans, methods, and results. Periodic conferences of weed workers would help accomplish this objective.

2. The application of fundamental weed research work done in certain states to problems in neighboring states or the entire region, resulting in increased utilization of the results and avoiding unnecessary duplication of effort. Examples are life history studies of certain weeds, and studies of the trends of organic root reserves in perennial weeds.

3. The co-ordination of the various experiment station and Bureau of Plant Industry plans of experiment or methods of attack on certain weed problems of regional importance to permit direct comparison of the results in different parts of the region and a quicker solution of the problem than would be possible through independent research at the various stations under different plans. An example of the value of this type of cooperation is found in the comprehensive and co-ordinated information available on the control of field bindweed as a result of the uniform plans of experiment adopted at the conferences of research workers at Ames, Iowa in 1936 and at Lincoln, Nebraska in 1940.

The Advantages of Close Cooperation Between Research and Action Agencies.

The North Central States Region has some outstanding examples of successful weed control programs that are the result of close cooperation between the state experiment stations and the Bureau of Plant Industry on the one hand and State Departments of Agriculture, and extension services of the State Colleges on the other. Some of the advantages of such close cooperation are as follows:

1. Research workers having close contact with the action programs are able to study the practical weed control problems facing these programs and the degree to which experimental results developed by research are meeting them.

2. The weed control action programs are more likely to be successful when based, so far as possible, upon sound scientific findings from carefully planned research.

3. Research workers can through representation at state, regional, and district meetings, assist in presenting the results of their experiments to the farmers in their respective states.

4. Research agencies should make available to the action agencies their experimental results as rapidly as is consistent with the reliability of the results by keeping up-to-date the publication of these data in bulletins, circulars, or periodical articles.

5. Action agencies are in excellent position to assist in carrying on practical research in studying the application of results obtained on experiment stations to the practical problems and conditions prevailing on farms, highways, railroad rights-of-way, etc. A systematic studying and recording of these results undertaken cooperatively by the action and research agencies causes more rapid advancement of both programs.

6. A fertile field for cooperation between action and research agencies is in the conducting of relatively simple out-state experiments or semi-demonstrations that permit a study of the influence of the variable factors of climate and soil and at the same time familiarize the public with the more promising weed control methods under study.

7. Since experiment stations are organized to conduct research efficiently and have the advantage of long experience and highly trained personnel, the experimental work should be carried on, by or in cooperation with those stations.

The Advantage of Cooperation Between Research Workers and Commercial Companies

1. Through cooperation with commercial companies, research workers can evaluate, without bias, the various products such as cultivation machinery, chemical spreaders, chemicals, burners, threshing and seed-cleaning, and feed-grinding machinery, and thereby facilitate their improvement.

Weed Problems Needing Greater Attention from Research

The committee is aware of the considerable number of weed problems in the North Central States Region that are not being studied adequately by existing research programs. A few rather critical needs for fundamental research to complete our fund of basic information on weed control and lay the foundation for continued progress in developing effective practical methods are as follows:

General Research Problems.

1. Life history and rate of development studies of troublesome weeds other than those which have been studied similarly in the past.

2. The determination of the critical points at which restoration of root reserves begins after cultivation or shoot-cutting in perennial weeds similar to that done on field bindweed.

3. A study of the light, moisture, and nutrient relations of weeds and competing crops, both under cultivation and under range and pasture conditions.

4. Studies of the action and fate of various herbicides in the soil and the factors that influence the differences that occur.

5. Studies of the principles governing the toxicity of herbicides and other characteristics that differentiate between those that are satisfactory and those that are not.

6. Continuation of studies toward improvement in cultivation and cropping methods for the control of perennial weeds.

Research Problems of an Immediately Practical Nature.

1. The development of cropping systems and roations for the control of troublesome annual weeds, e.g. mustards in the north and ragweed east of the Mississippi river.

2. The development of inexpensive methods of weed control on low-value land including pasture and range lands.

3. The development of methods for the control of erosion during the eradication of perennial weeds.

4. The improvement of tillage machinery for shoot-cutting of perennial weeds while at the same time preparing the land to resist erosion.

5. The discovery of effective perennial grass and legume combinations for the control of perennial weeds.

6. The discovery of new, inexpensive herbicides that may be easily and safely applied.

7. The continuous testing of herbicides on the market to determine their relative effectiveness and the optimum dates and rates of application.

8. The improvement of machinery for applying sodium chlorate and other chemicals.

9. The occurrence of weed seeds in crop seeds and in feed grains and screenings sold for feed.

10. The development of cropping methods that reduce the amount of weed seeds that are allowed to mature in crops.

11. The improvement of machinery for cleaning crop seeds to remove weed seeds.

12. The improvement of tillage, seeding and harvesting machinery to provide for less transportation and scattering of weed seeds, roots, or other propagating parts.

13. The possibility of greater use of livestock in the control of weeds under range and temporary pasture conditions.

14. The control and eradication of weeds on golf courses and lawns.

15. Improvement in methods of accomplishing soil sterilization for weed control.

16. Improvement in methods of eradicating weeds on railroads, highways, and fence lines.

17. Development of satisfactory methods of weed control on public grounds, such as school grounds, church yards, cemeteries, playgrounds, and parks.

Motion for Adoption by Timmons
Seconded by Schrader
No discussion
Passed

Mr. Leonard: We will now hear from the Resolutions Committee. Dr. H. K. Wilson of the University of Minnesota is the chairman and will give the report.

RESOLUTIONS COMMITTEE REPORT
Dr. H. K. Wilson, Chairman
Professor of Agronomy
University of Minnesota

WHEREAS the various states and interested groups working independently are unable to integrate the magnitude of weed problems that menace the agriculture of this area -

BE IT RESOLVED, that the North Central States Weed Control Conference assembled at Omaha, Nebraska, November 16 and 17, 1944, believes that the Congress of the United States should provide adequate funds for the creation of a Weed Division in the United States Department of Agriculture.

1. To coordinate a weed control program.

2. To conduct research on the methods of prevention and control of weed plants.

BE IT FURTHER RESOLVED, that the North Central States Weed Control Conference cooperate with the Western Weed Control Conference in securing necessary legislation.

WHEREAS, the state educational and extension programs of weed control lack essential interstate coordination -

BE IT RESOLVED, that we believe that the United States Department of Agricultur should employ weed extension workers for the purpose of furthering and coordinating the educational activities among the various states.

WHEREAS, publicly owned lands, particularly on watersheds from which irrigation waters arise, are often infested with noxious weeds which are a menace to extensive areas of agricultural lands -

BE IT RESOLVED, that this Conference go on record as recommending a definite government policy directed toward the control of these weeds and that funds be appropriated to responsible custodial agencies.

WHEREAS, the free interstate movement of weed-containing feed, grain, and forag is a menace to effective weed control -

BE IT RESOLVED, that federal legislation be enacted for the control of feed, and other agricultural materials in interstate commerce, so as to prevent such weed seed dissemination.

WHEREAS, certain governmental agencies are concerned with interstate shipments of feeds -

BE IT RESOLVED, that we request the Commodity Credit Corporation or any other agency responsible for the importation or distribution of interstate shipments of grains, hays, or other agricultural commodities, to insure that such materials be free from noxious weed seeds and plants or to otherwise comply with state laws and regulations governing their import.

WHEREAS, the individual state weed and seed laws lack uniformity -

BE IT RESOLVED, that a committee of this Conference be appointed to work with the Association of Official Seed Analysts, the International Crop Improvement Association, the State Agricultural Commissioners, and other agencies concerned with agricultural seed laws to formulate uniform weed and seed laws.

WHEREAS, many new untried herbicides are being placed on the market -

BE IT RESOLVED, that the members of this Conference recommend that the individual states take necessary measures to prevent undesirable exploitation.

WHEREAS, the present conference has proved highly successful -

BE IT RESOLVED, that the members of the Conference recommend that a permanent organization be effected leading to annual meetings of a similar nature.

WHEREAS, much valuable aid has been given to the states by the Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture -

BE IT RESOLVED, that the members of this Conference express their appreciation to the workers in the Bureau for their active participation and splendid cooperation in the furtherance of weed research and state weed control programs.

We, the members of the various organizations, commercial interests, and states represented at the North Central States Weed Control Conference assembled in Omaha, Nebraska, November 16 and 17, express our appreciation -

1. To the Agricultural Committee of the Chamber of Commerce of Omaha.
2. To the Omaha World-Herald for its support.
3. To Radio Station WOW for the interest of its officials in the conference.
4. To the representatives from Saskatchewan, California, Colorado, and Wyoming for their interest, attendance, and participation in our conference.
5. To the Nebraska State Department of Agriculture and Inspection.
6. To the College of Agriculture, University of Nebraska.
7. To the Union Pacific Quartet for their entertainment.
8. To those individuals who planned the conference.
9. To those persons participating in the two-day program.
10. To the Paxton Hotel for the accommodations provided.

Motion for Adoption by Wilson
Seconded by Frazier
No discussion
Passed

Mr. Leonard: The last committee report is on Plans for Future Meetings by Mr. T. F. Yost, State Weed Supervisor of Kansas who is the chairman.

PLANS FOR FUTURE MEETINGS
COMMITTEE REPORT

Mr. T. F. Yost
State Weed Supervisor
Kansas State Board of Agriculture

Realizing the tremendous economic losses caused by weeds to agriculture and related industries in the Nation as a whole, and particularly in each of the North Central States, we feel that it is of far-reaching importance for all interested in weed control and eradication in that area to meet in an annual conference to discuss problems of weed regulation and research, to exchange ideas, and take such actions as may be helpful for the improvement of research, educational, and regulatory work on weeds and weed control.

With these things in mind, we submit the following recommendations:

1. This group shall be known as the North Central States Weed Control Conference.

2. Meetings of the Conference shall be held annually at a place to be designated by the executive committee.

3. For the present, the area included in this Conference shall be the following states: North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Ohio, and Michigan.

4. The following persons shall be eligible to membership in the Conference:

   (a) Employees of the state departments in charge of weed and seed regulatory and control programs, including directors of such state departments;

   (b) Weed research workers and extension and other educational workers engaged in weed control, connected with state colleges, universities, and experiment stations, or the Federal government;

   (c) Representatives of commerical concerns manufacturing or selling herbicides or equipment used in weed eradication, or engaged in seed merchandising;

   (d) Others interested in weed control.

5. Voting membership shall be limited to those in groups a or b in paragraph 4.

6. Membership dues shall be by states with an annual fee of 15 dollars, which shall be due and payable to the secretary-treasurer January 1 of each year.

7. At each annual meeting, a President, Vice-President, and a Secretary-Treasurer shall be elected, who shall serve without pay. The officers shall be elected from groups a or b. These officers shall constitute the Executive Committee. The President shall appoint a Program Committee for the annual meeting.

8. The secretary-treasure is authorized to pay all bills when due. An audit and financial statement shall be presented at each annual meeting.

9. The officers shall arrange for the preparation and mailing of a complete report of the proceedings of the annual meeting. A copy of the proceedings shall be sent to those designated by the state representatives, and to others upon request.

10. Each state shall select a representative whose duties shall be to act as clearing agent for the Conference in his state and to promote the objectives of the Conference.

Motion for Adoption by Yost
Seconded by Willard
No discussion
Passed

Mr. Yost: This committee is also the nominating committee, and Dr. Willard will give this report.

Dr. Willard: We nominate T. F. Yost of Kansas for President. Our choice for Vice-President is a man from the research group, and is equally well known to everyone here. He has appeared on the program. We nominate Dr. F. D. Keim of the University of Nebraska. For Secretary-Treasurer we nominate Mr. A. H. Larson of the University of Minnesota. Nominations may also be made from the floor. (No further nominations). If there are no further nominations, I move that these men be unanimously elected.

Mr. Schrader: I second the motion. (No discussion) (Verbal vote of "Aye")

Mr. Leonard: It has been unanimously approved that the men just nominated be elected.

Mr. Kephart: I have received a letter from Jack Evans, who is now a Major in England. I make a motion that the secretary write a letter to him and let him know of our progress. (Seconded and passed)

Mr. Swenson: Mr. Chairman, in behalf of our Commissioner of Agriculture, Mr. Trovatten, who could not be here, I extend a cordial invitation to members of this conference to meet in Minnesota in 1945. (Acceptance deferred)

Mr. Rufus M. Howard, Director of the Nebraska Department of Agriculture and Inspection took over at this time to close the conference.

Mr. Howard: Is there anything else to come before this conference? I am sure that everyone feels that this has been a most successful meeting and one that will prove to have been very fruitful. I think it is gratifying to everyone interested to know that a permanent organization has been perfected here, and that the work will be carried forward. The program in the different states can be coordinated and in all be made more effective. That is what we are all interested in. I have heard many comments and there has certainly been unanimous sentiment that this has been a very successful meeting. The attendance has been very fine. If there is no other business, a motion is in order to adjourn.

Motion for adjournment.

The suggestion was made that the new officers stand.

Mr. Yost: We do not fully realize the responsibility that has been thrust upon us, but we do thank you for your confidence. I am sure that the new officers will do the best they can and we also want to assure you that you will all have something to do. We are not going to do all the work. We are depending on you and are sure that you will respond. The success in the future will depend on all of us.

Dr. Keim was not in the room.

Mr. Larson: I agree with what Mr. Yost has said.

Motion seconded and meeting adjourned.

ACKNOWLEDGEMENT

In behalf of the sponsors of the North Central States Weed Control Conference, the temporary secretary wishes to express appreciation to all those who contributed to the success of the conference either by presentation of reports and papers or by assisting in organization or committee action. It is especially noteworthy that, in spite of present difficulties of available time and travel, everyone assigned to the program accepted and very capably handled his assignment. This was especially appreciated by those arranging the program.

Further acknowledgement is hereby given for the excellent cooperation from those on the program in their prompt submission of copies for inclusion in the Report of Proceedings. The material submitted appears in its entirety with the exception that changes were made to facilitate uniformity of presentation. Some of the discussion carried on between papers has been omitted, but important points have been covered.

Noel S. Hanson
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Conference.
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